Dynamic Multi-Modality Fused Imaging, Analysis, Computer Aided Diagnosis System

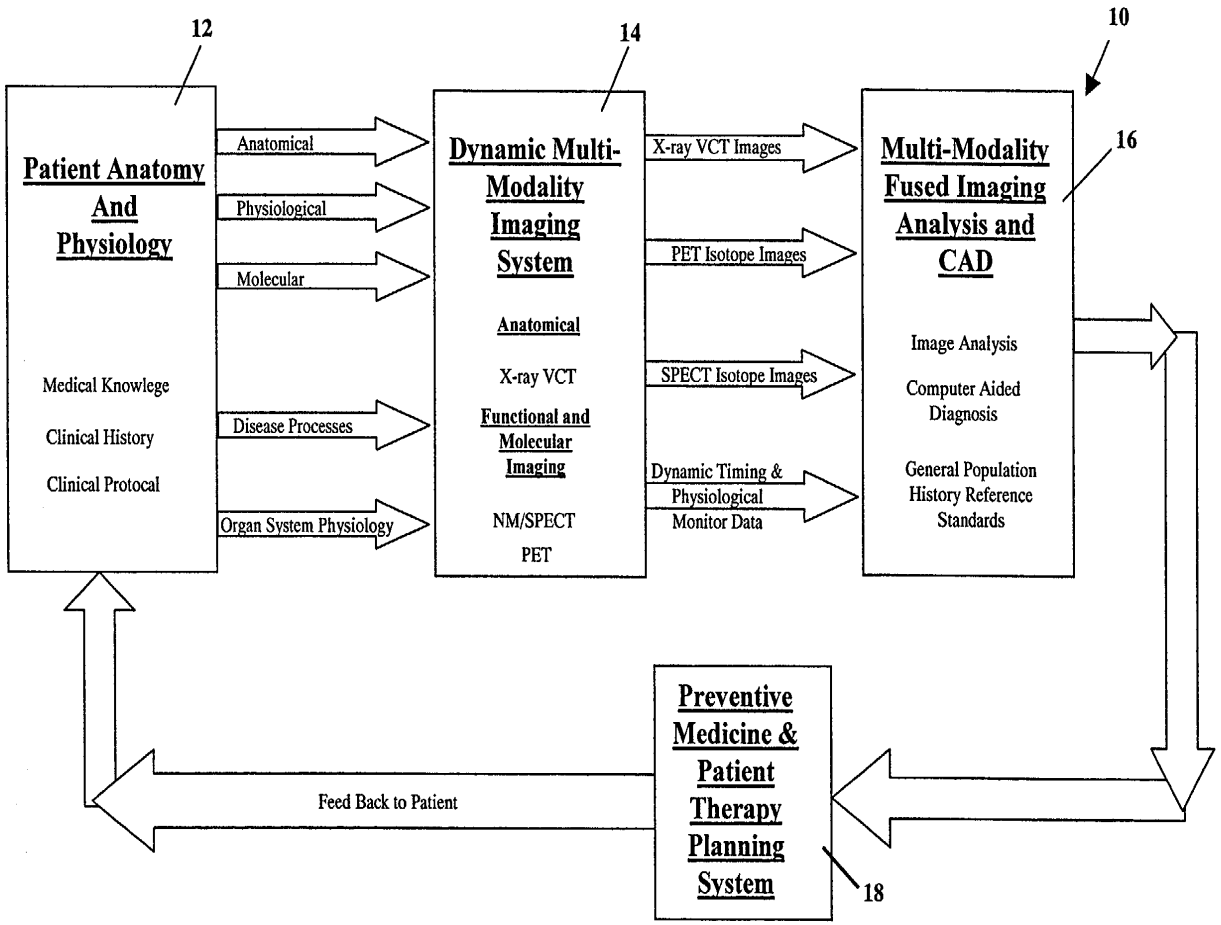


Figure 1

Multi-Modality Imaging System with Common Focused 2D Curved Detector

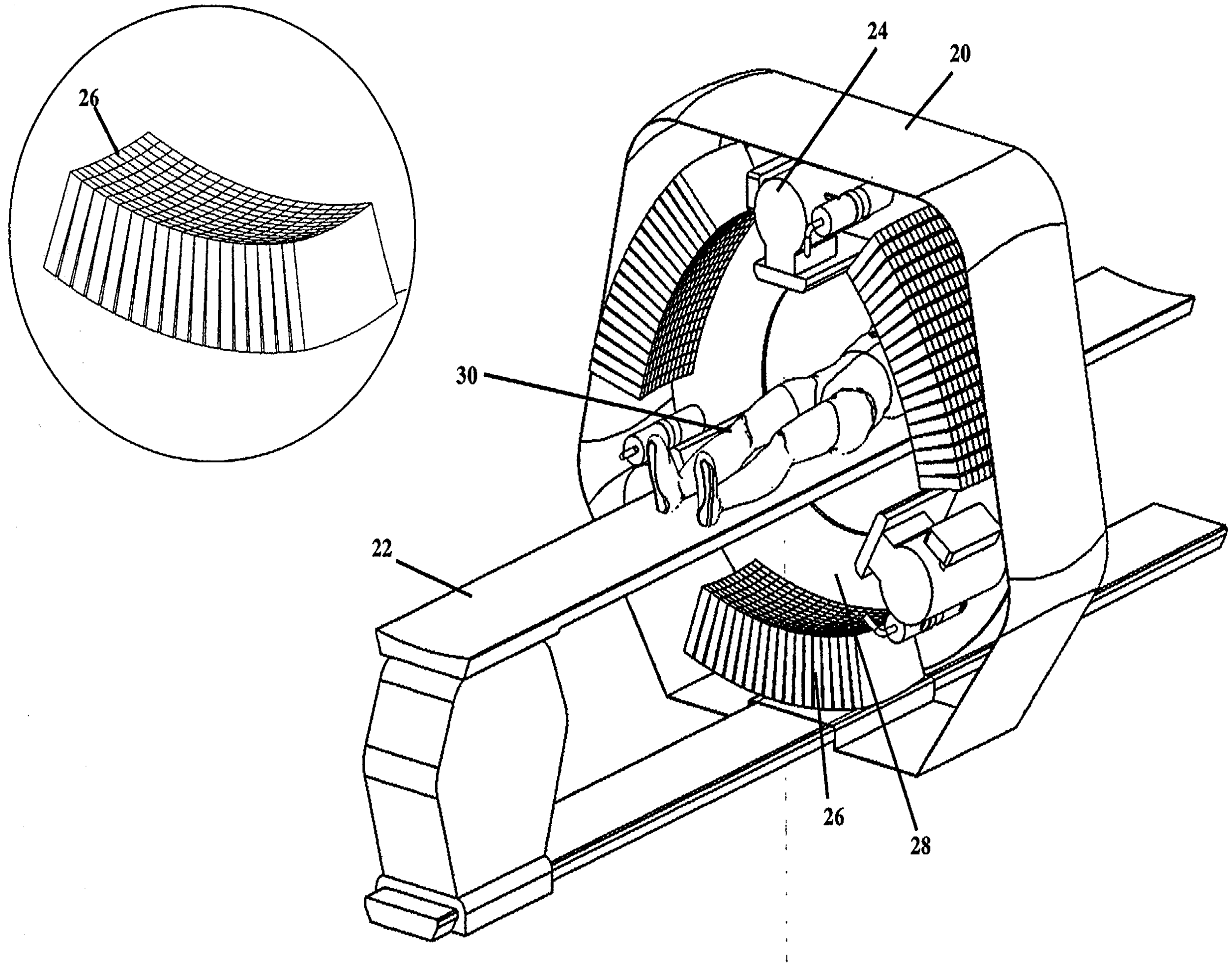


Figure 2

Overall Multi-Modality Imaging System Block Diagram

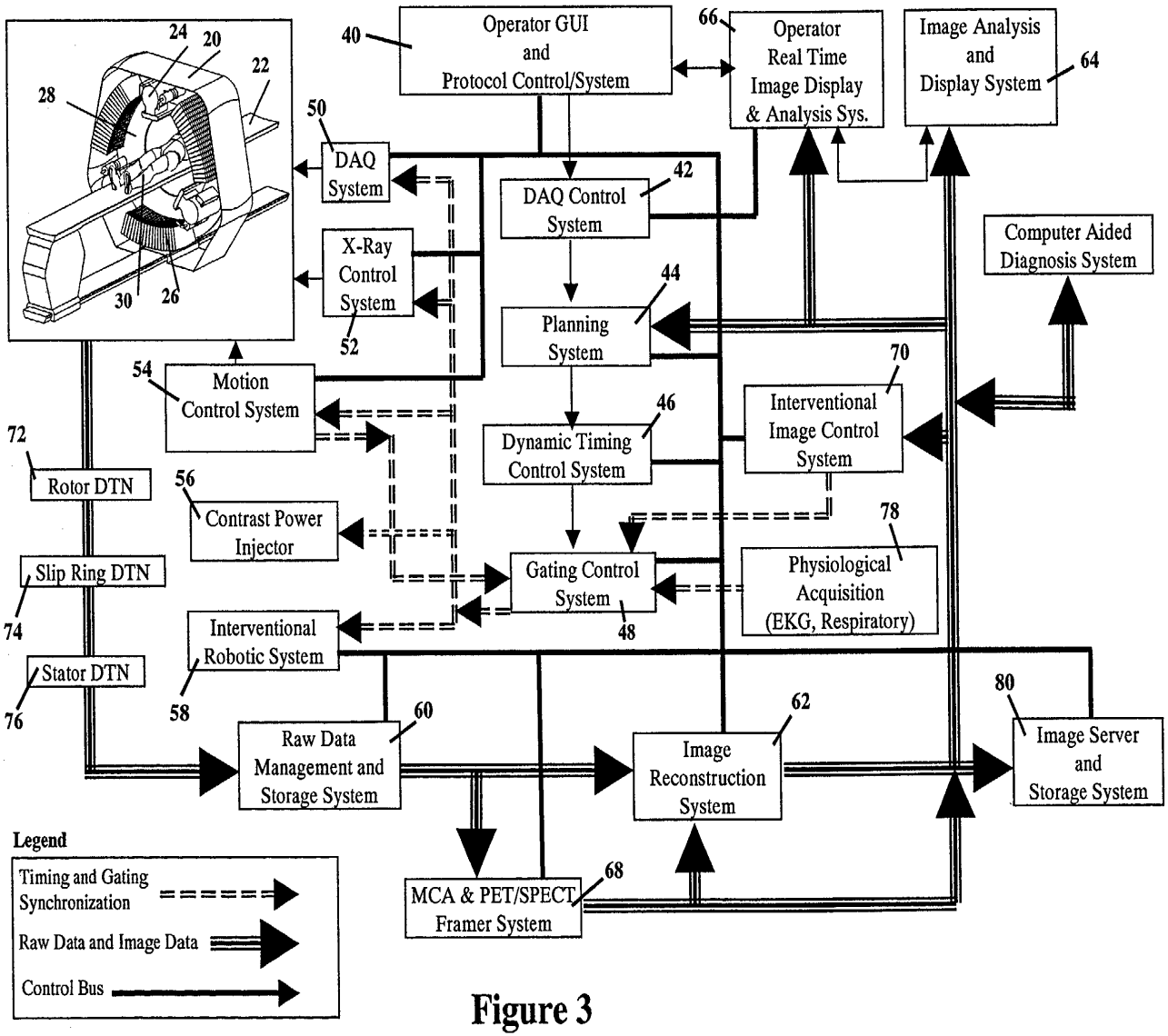


Figure 3

X-ray & Focused 2D Curved Detector Arrangement

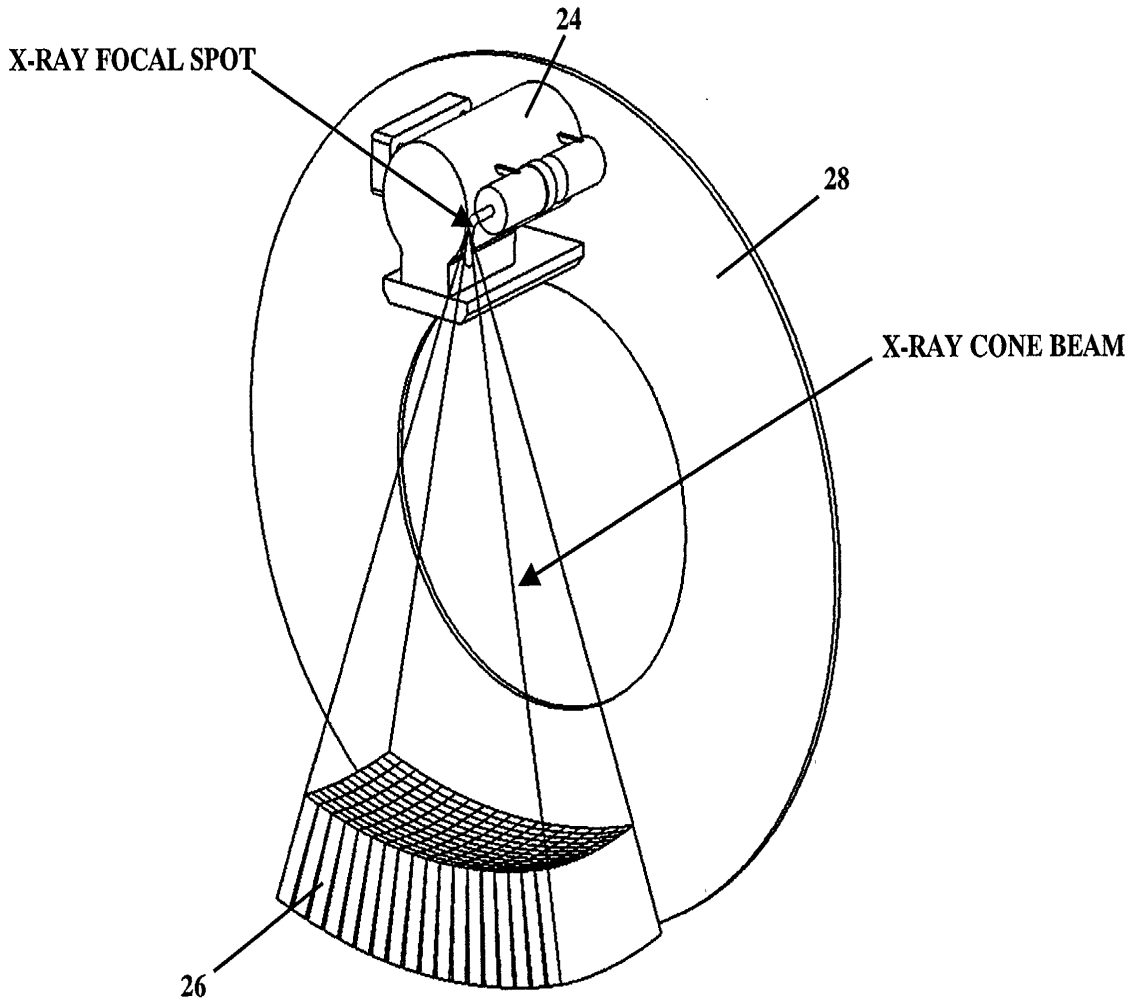


Figure 4

Cone Beam Source Collimation & Cone Beam Shaped Filter

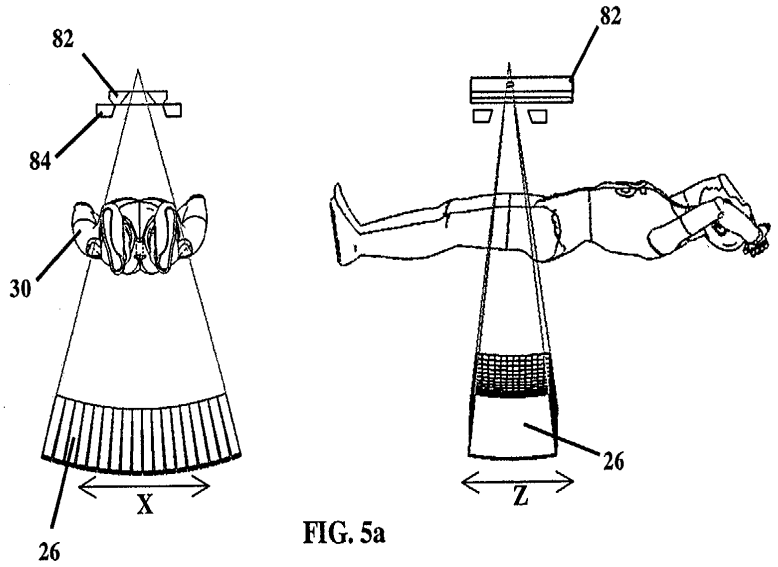


FIG. 5a

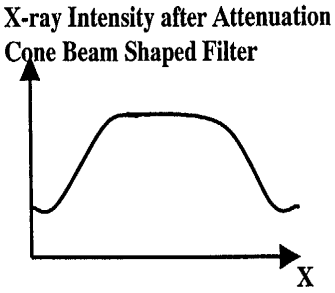


FIG. 5b

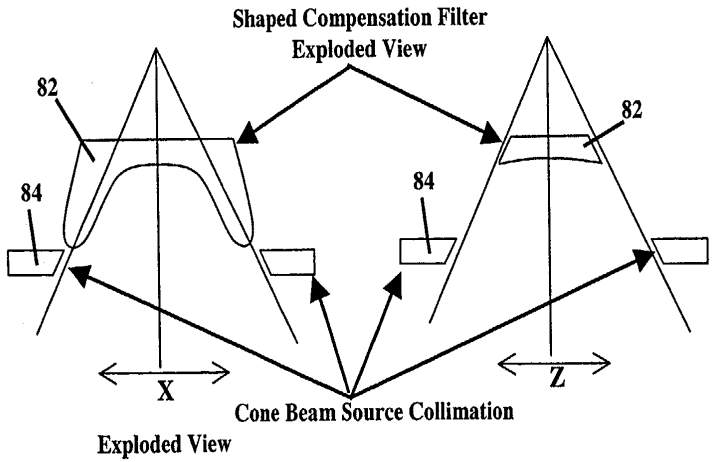


FIG. 5c

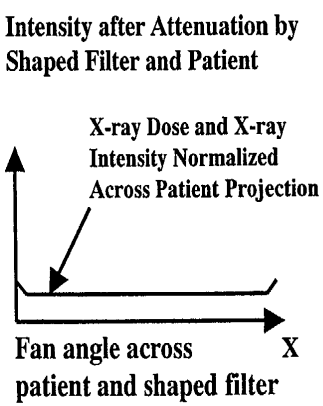
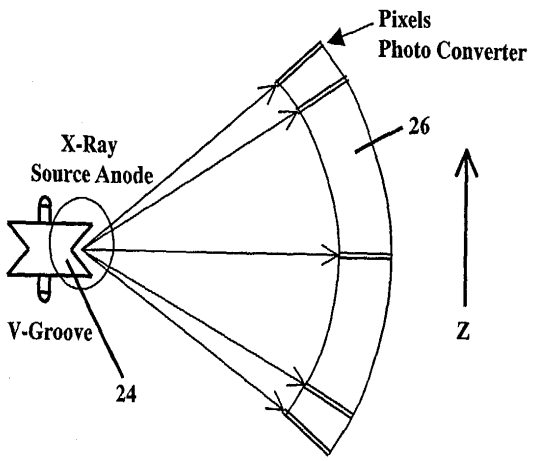


FIG. 5d

Figure 5

X-ray Cone Beam Focal Spot - Curved Detector Optics

Curved Detector to reduce spatial resolution loss and Best Conversion efficiency of X-ray



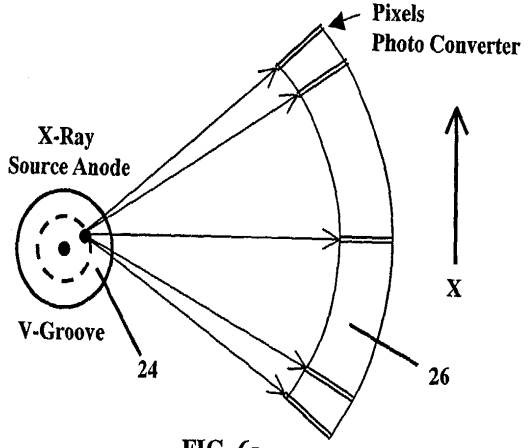


FIG. 6a

Focal spot from V-groove Type Anode has similar spot size appearance

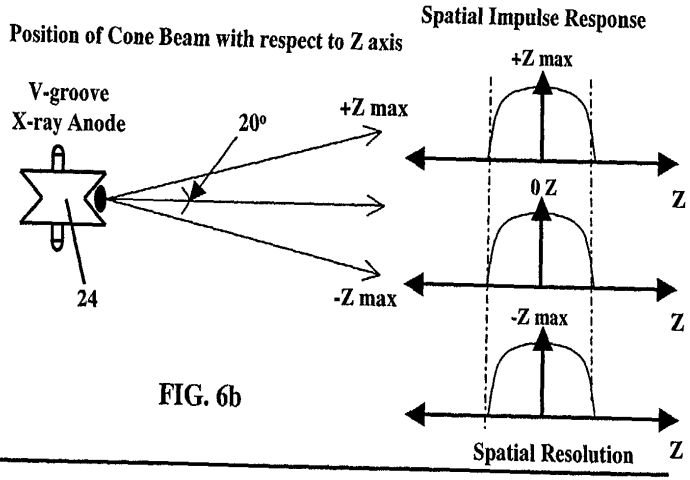


FIG. 6b

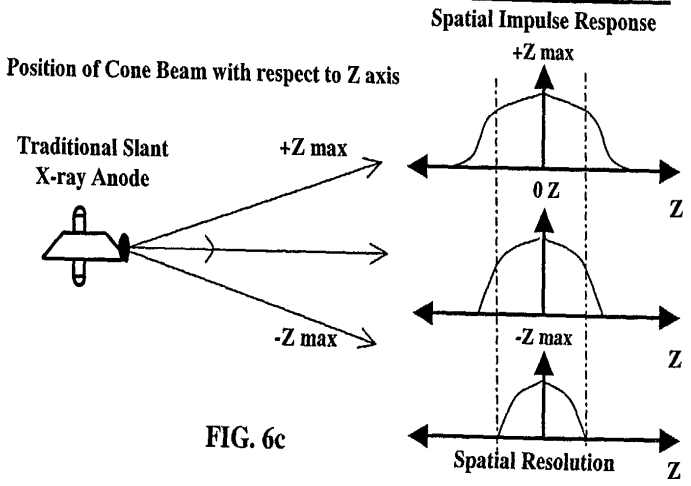


FIG. 6c

Figure 6

2 Dimensional Focal Spot Dithering for Improved Cone Beam Spatial Resolution

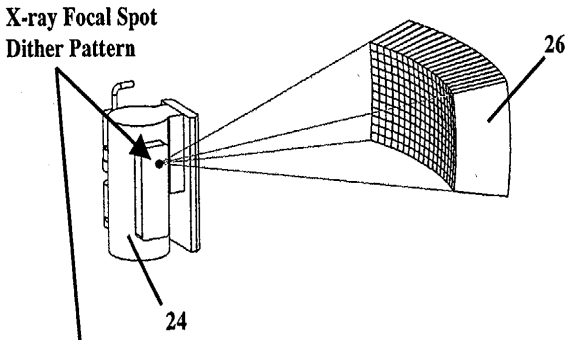


Figure 7a

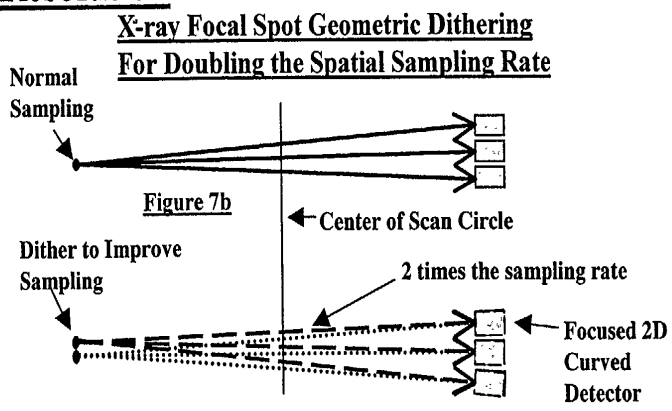


Figure 7c

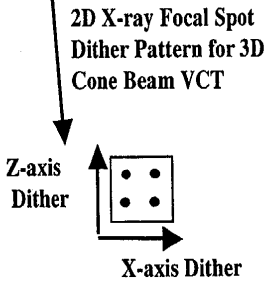


Figure 7d

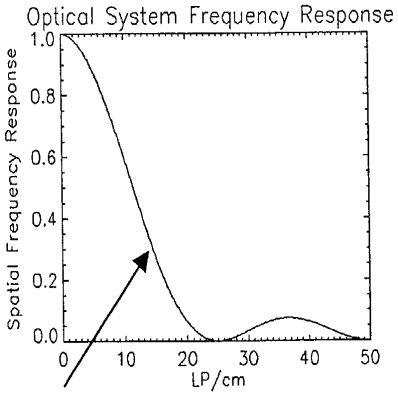


Figure 7e

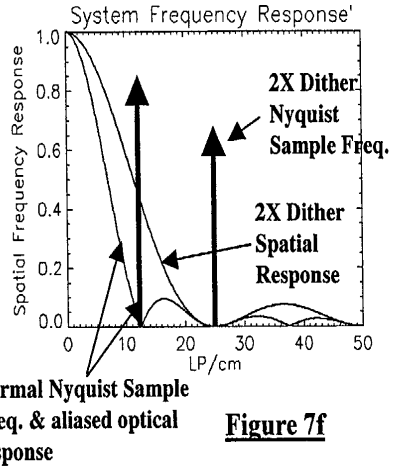


Figure 7f

Figure 7

Focused 2D Curved Detector Module

Focused Curved Detector Module

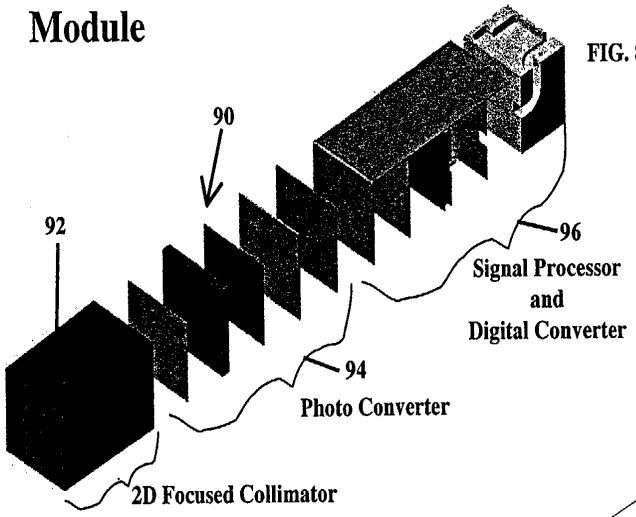


FIG. 8a

View Showing Focused 2D Anti-scatter Collimation with 2D Focused Pixels

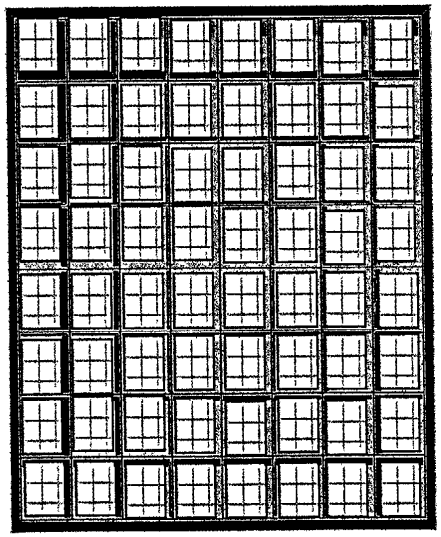


FIG. 8c

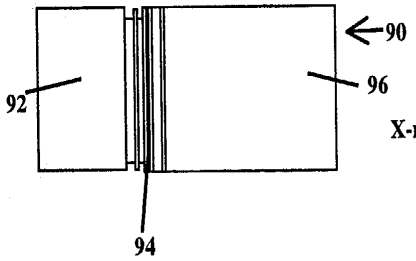
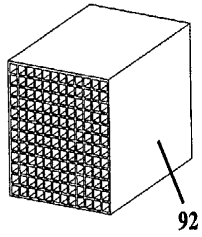


FIG. 8b



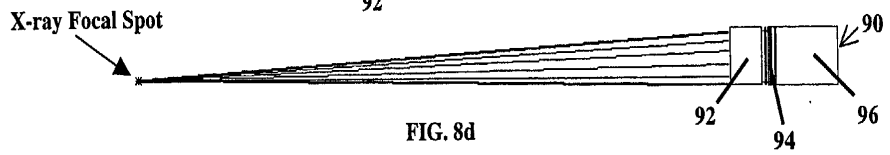


FIG. 8d

Figure 8

Focused 2D Area Detector with Adaptive Shaped X-Ray Optical Response

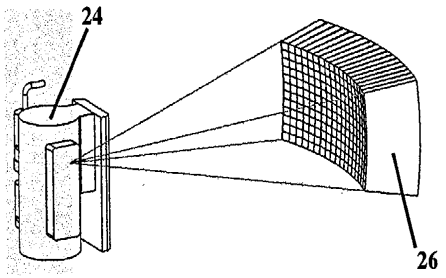
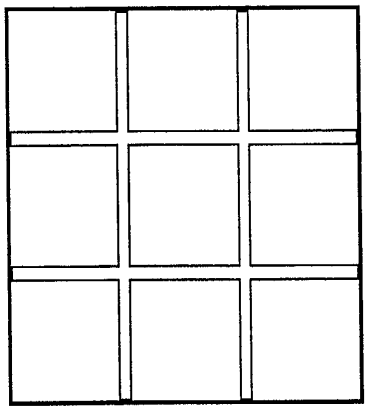


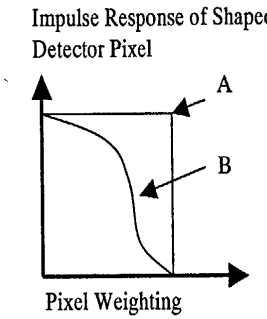
FIG. 9a

Impulse Response Shaping from Rectangular to Variable guassian Roll-off Function. Shaping may be Fixed or Controlled



Detector Pixel

FIG. 9b



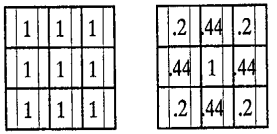


FIG. 9f

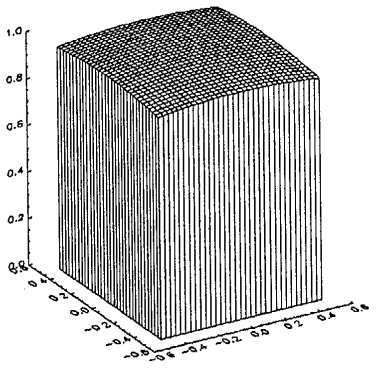


FIG. 9c

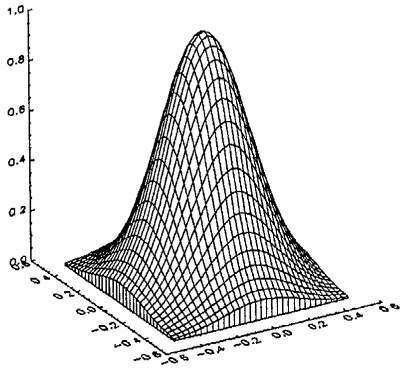


FIG. 9d

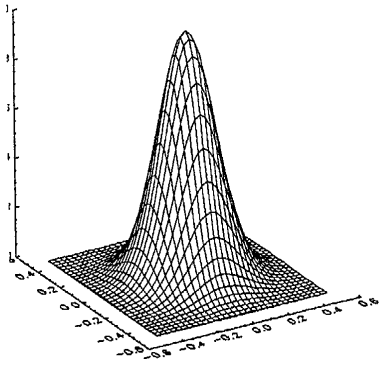


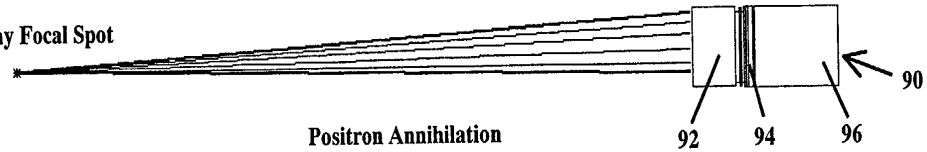
FIG. 9e

Figure 9

Multi-Modality XGA Detector Module

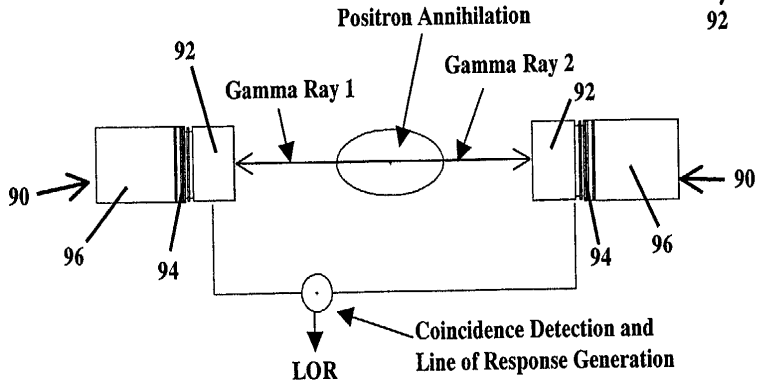
X-Ray Mode

FIG. 10a



PET Mode

FIG. 10b



NM/SPECT Mode

FIG. 10c

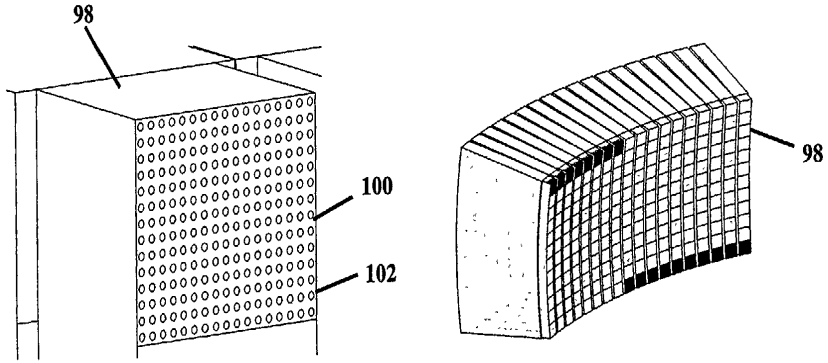


Figure 10

Detector Module Multi-Modality Collimation

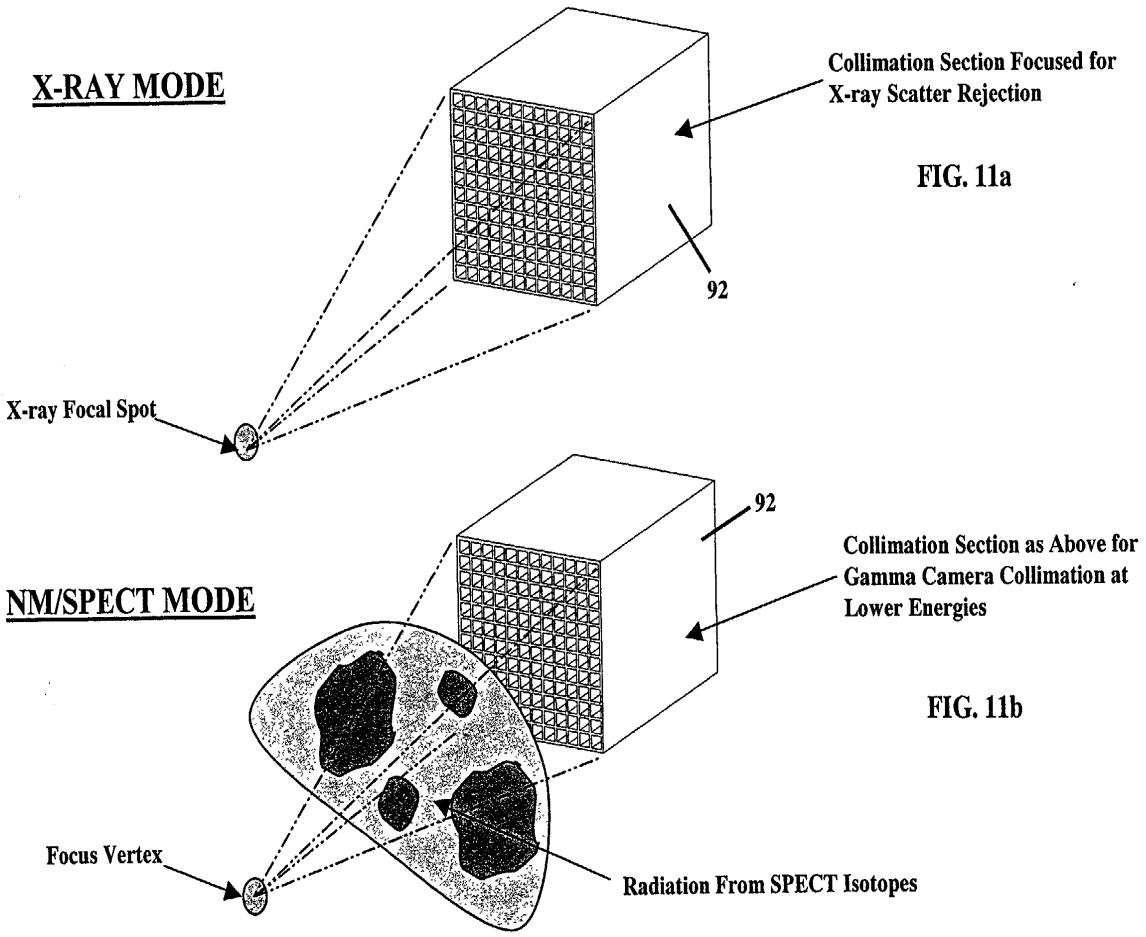


FIG. 11a

FIG. 11b

Figure 11

XGA Detector Module Signal Processing

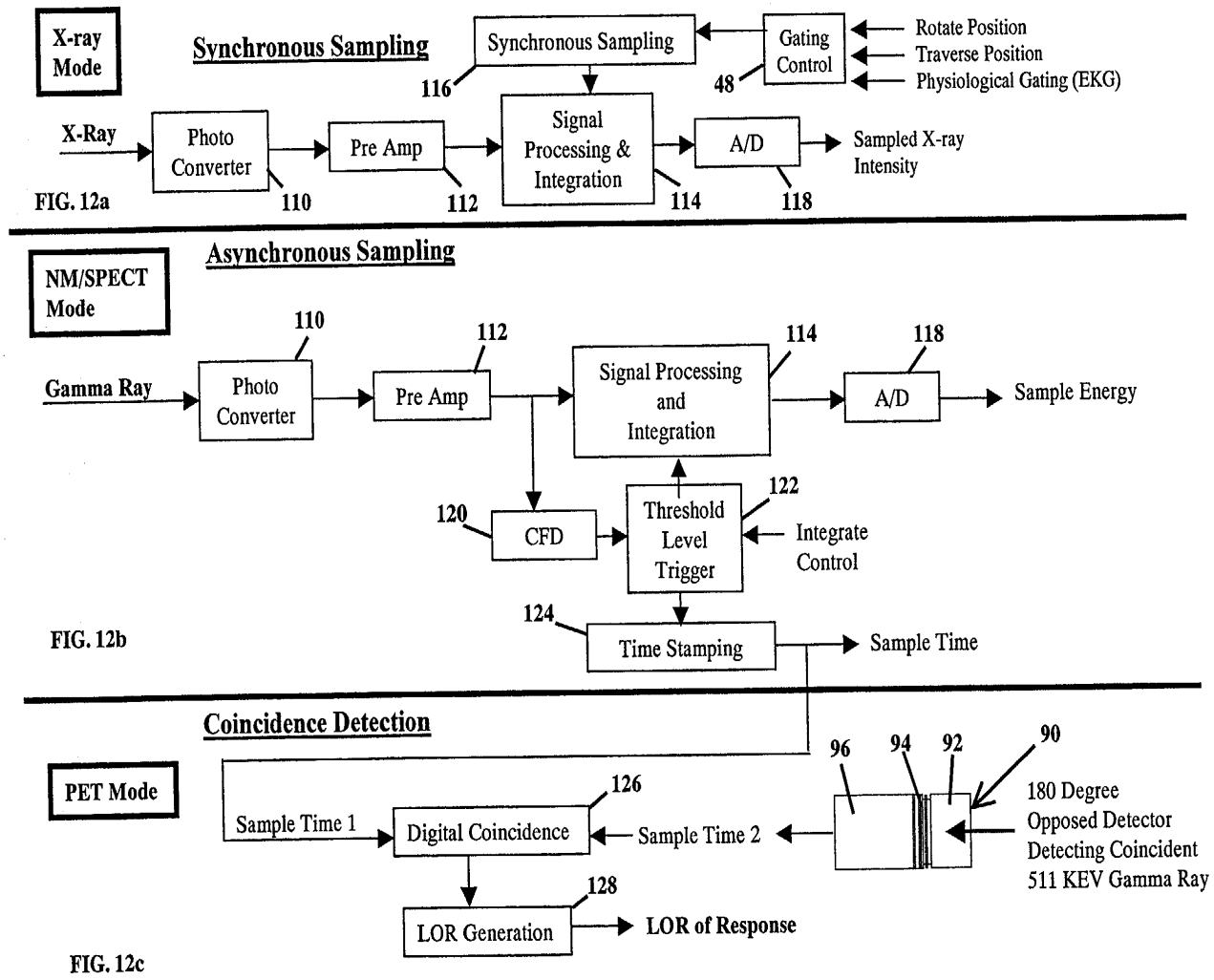


Figure 12

System with Optional PET Anti-Scatter Baffle

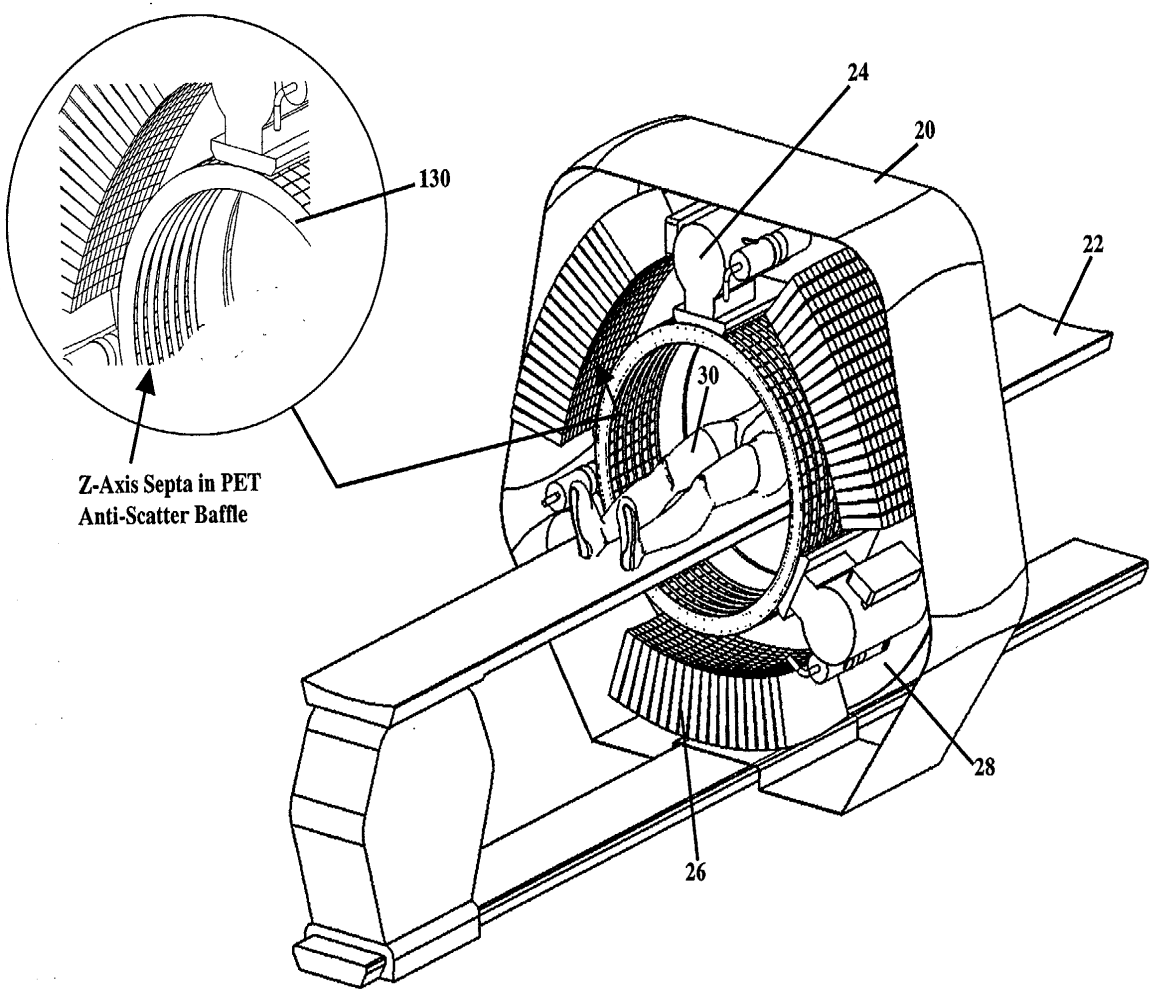


Figure 13

PET – Anti-Scatter Baffle SEPTA

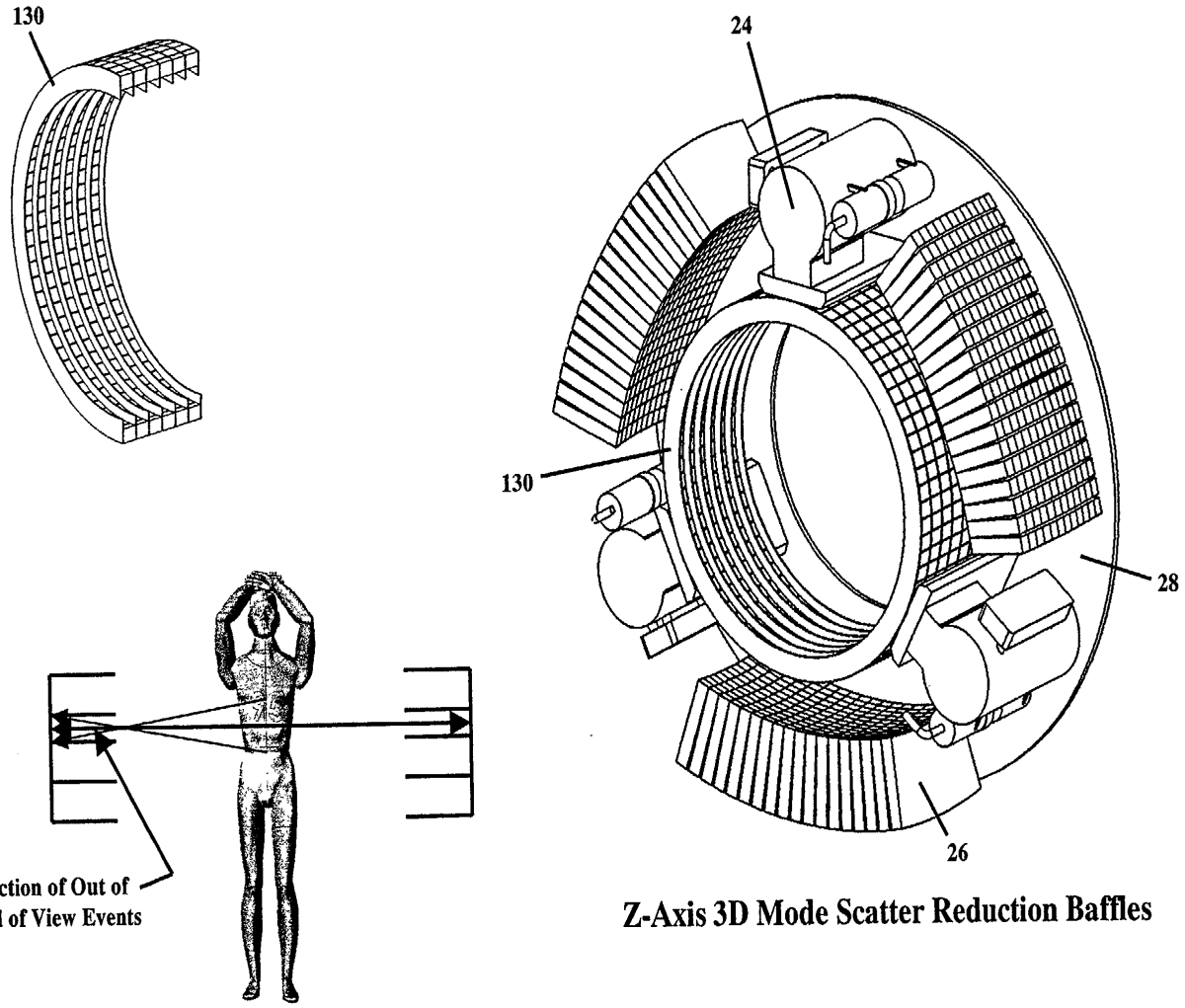


Figure 14

System With Cone Beam Focused NM/SPECT Collimation

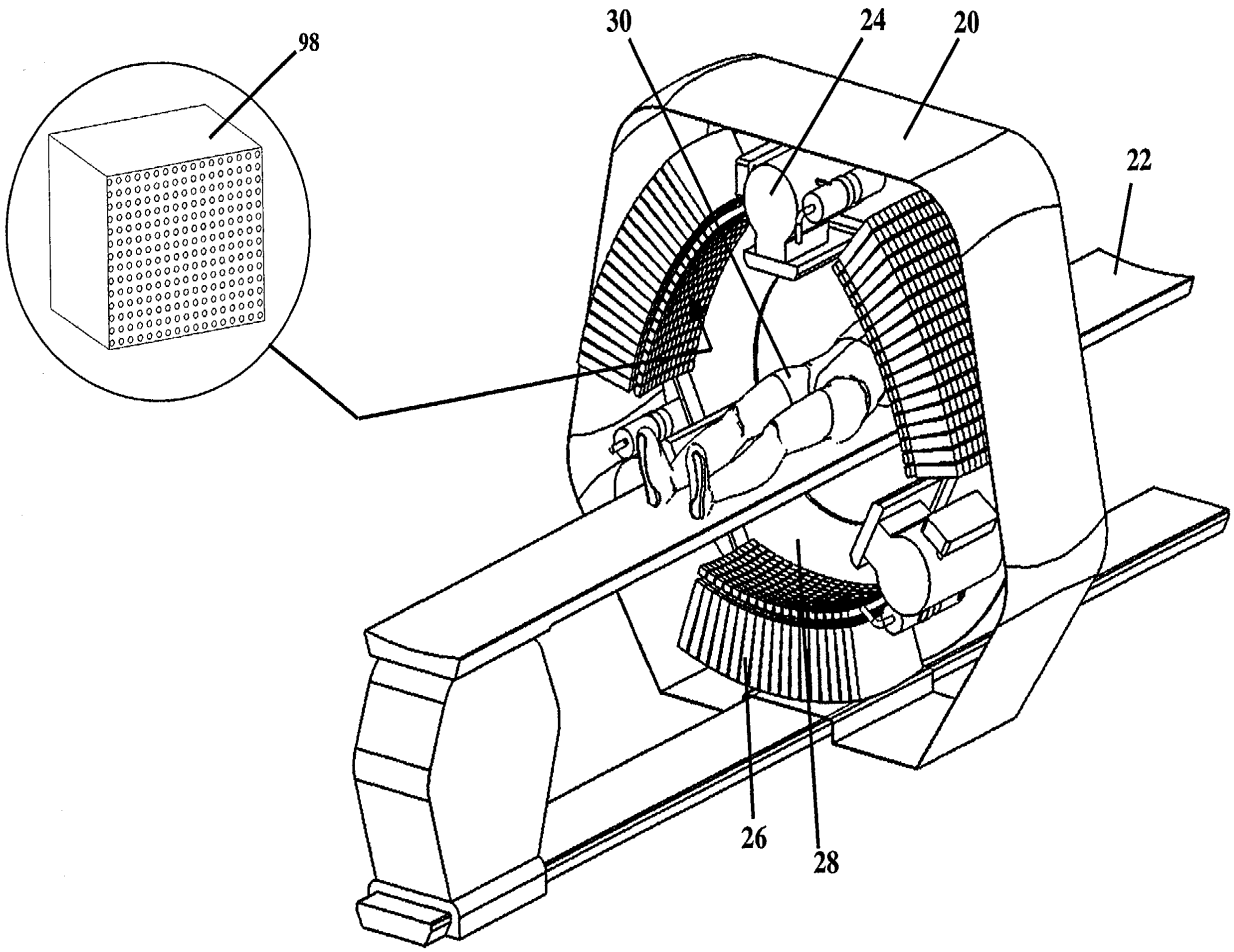


Figure 15

NM/SPECT Mode with Collimation Ring

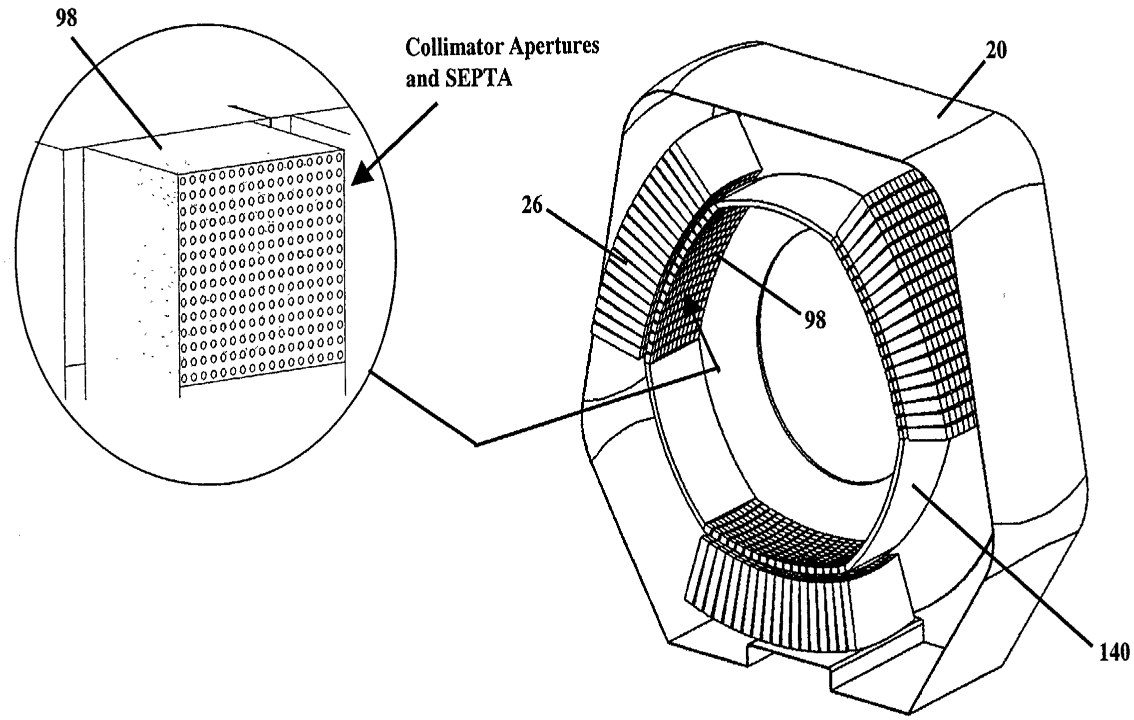
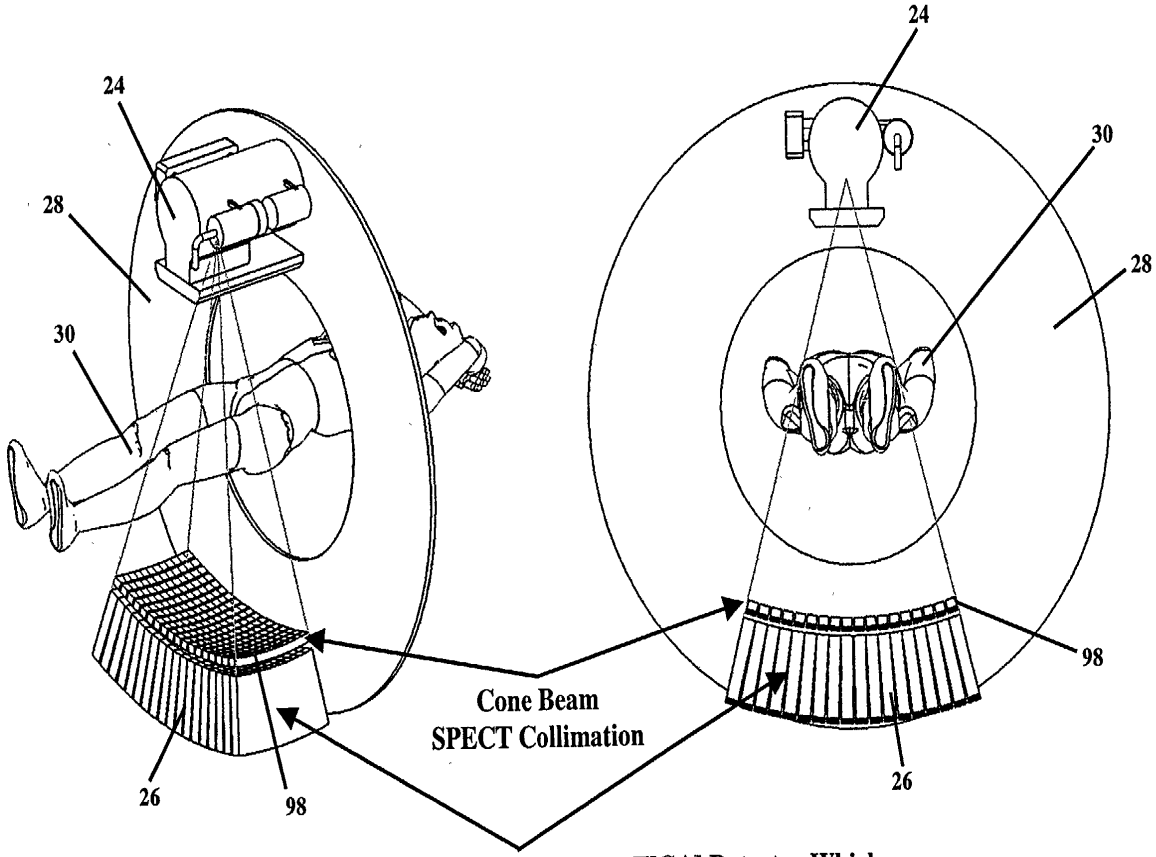


Figure 16

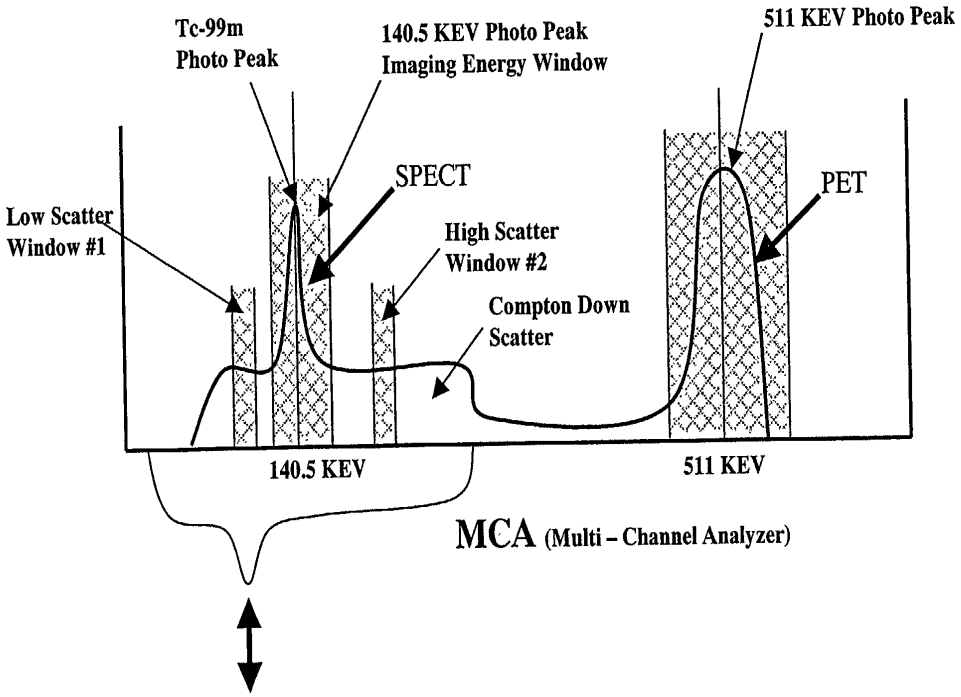
Cone Beam NM/SPECT LEHR Collimation and Focused 2D Curved Detector Array



X-ray Gamma Ray Area Detector. [XGA] Detector Which is Focused at Point Where X-ray Focal Spot is.

Figure 17

Multi-Isotope Scanning



- Scatter Correction and 511 KEV Photo Peak Suppression for SPECT Imaging
- NM/SPECT Detector Must Function with 511 KEV Isotope Present for Multi-Isotope Imaging

Figure 18

X-Ray Detector Scatter Rejection with Focused 2D Curved Collimation

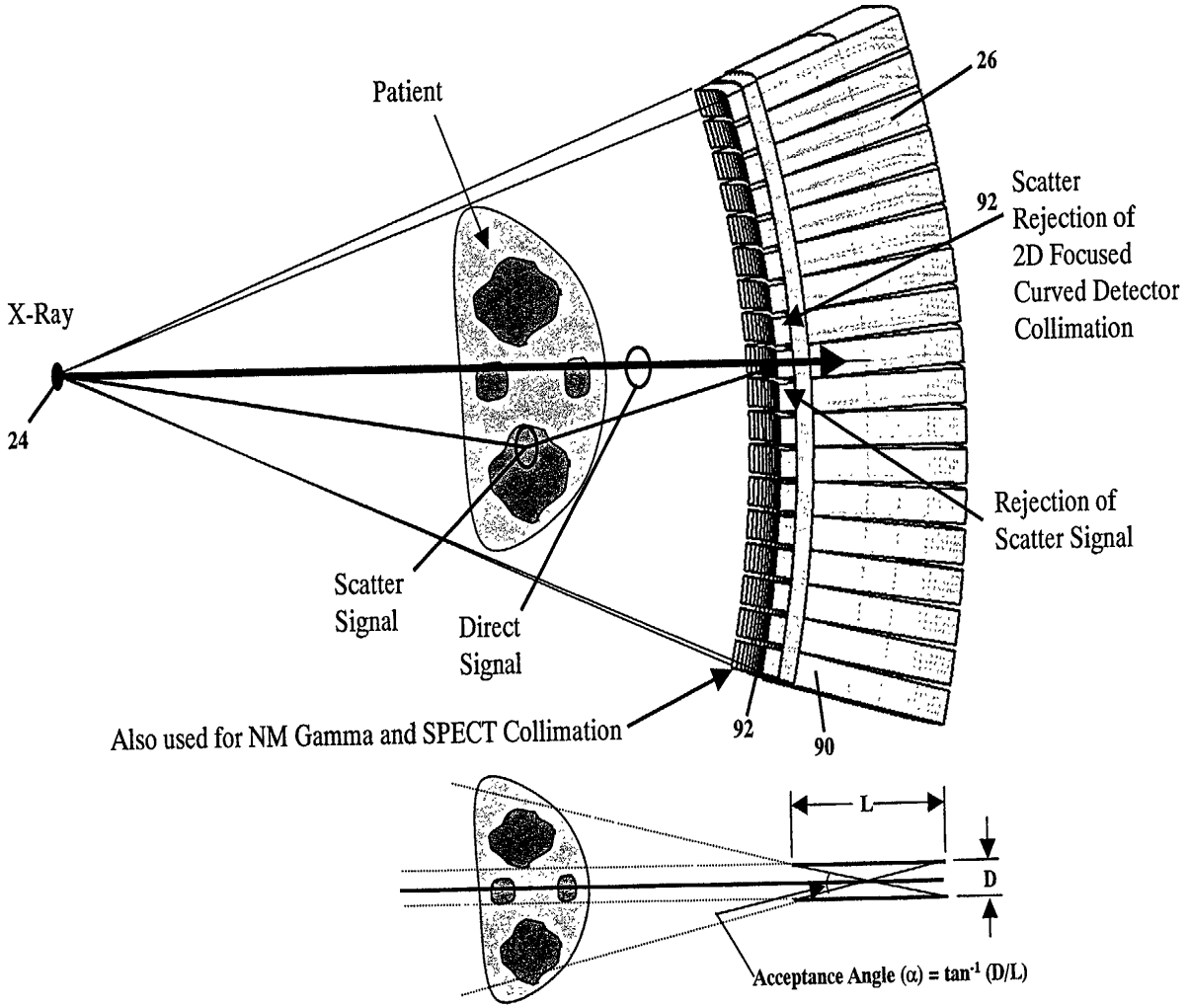


Figure 19

Sequencing of X-ray Sources for Adaptive Scatter Correction

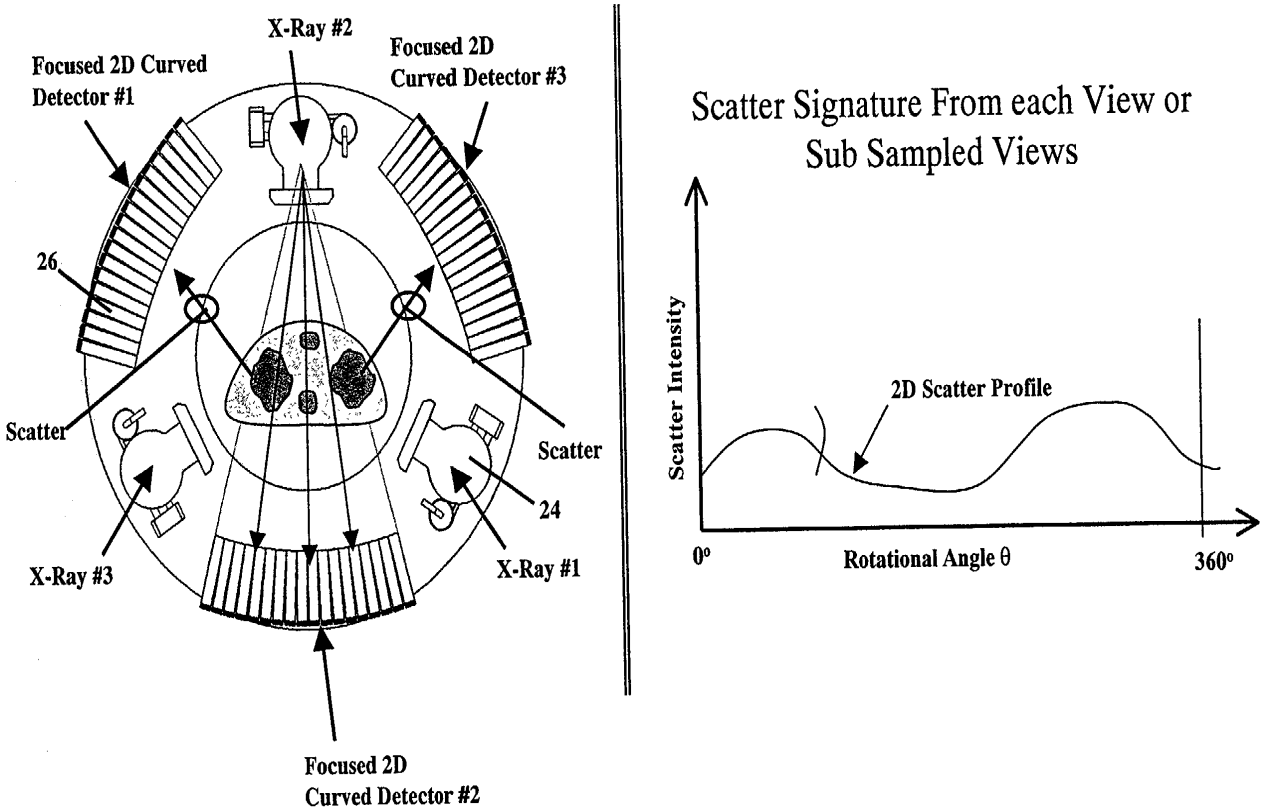


Figure 20

Modulation and Demodulation for Scatter Correction with Multiple Sources

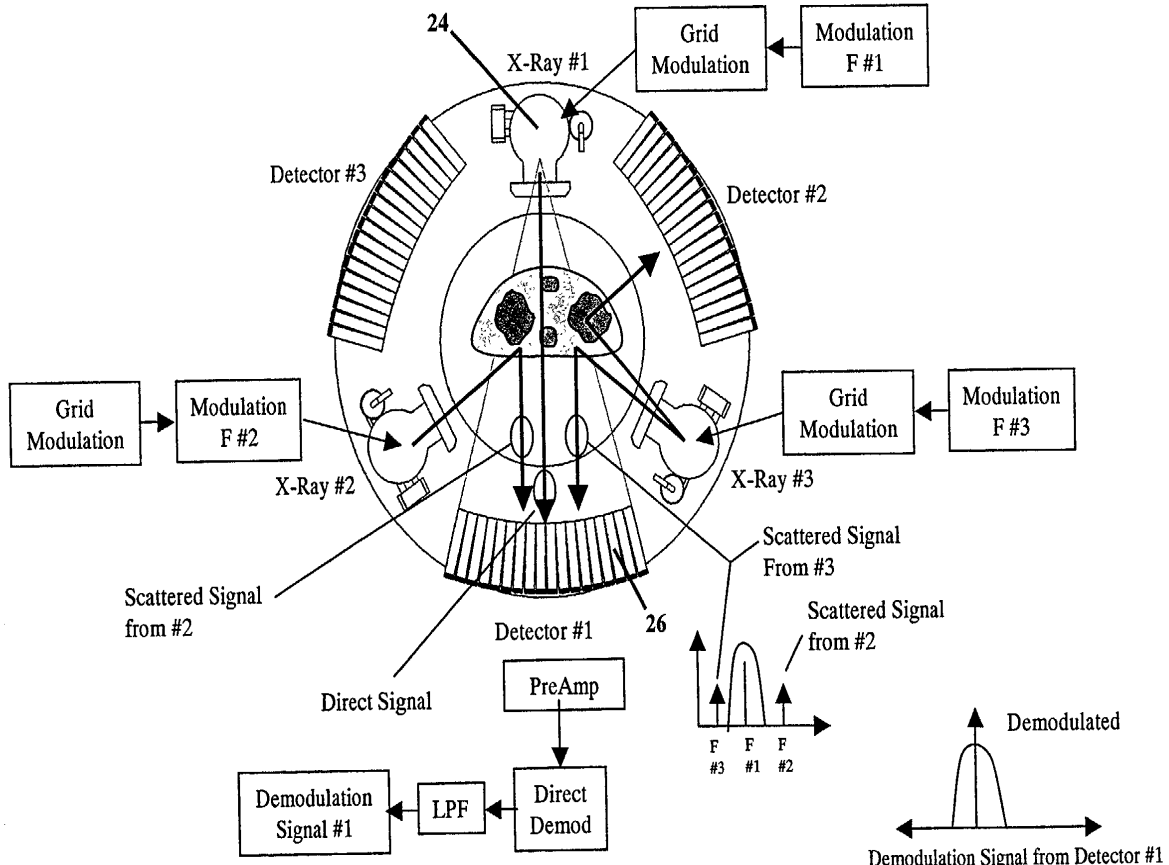


FIG. 21a

FIG. 21b

FIG. 21c

Figure 21

System Level Diagram of Modulation and Demodulation For Multiple Sources for VCT

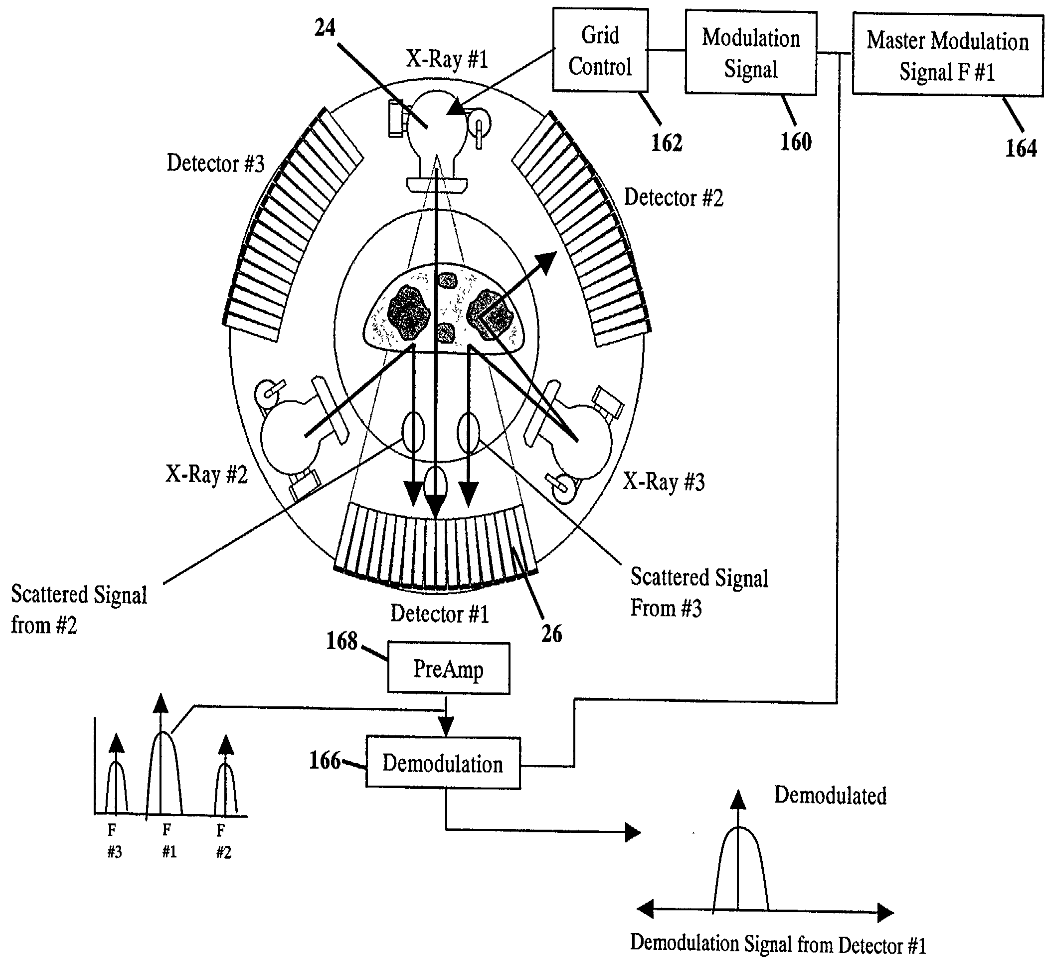


Figure 22

Step and Shoot VCT Imaging

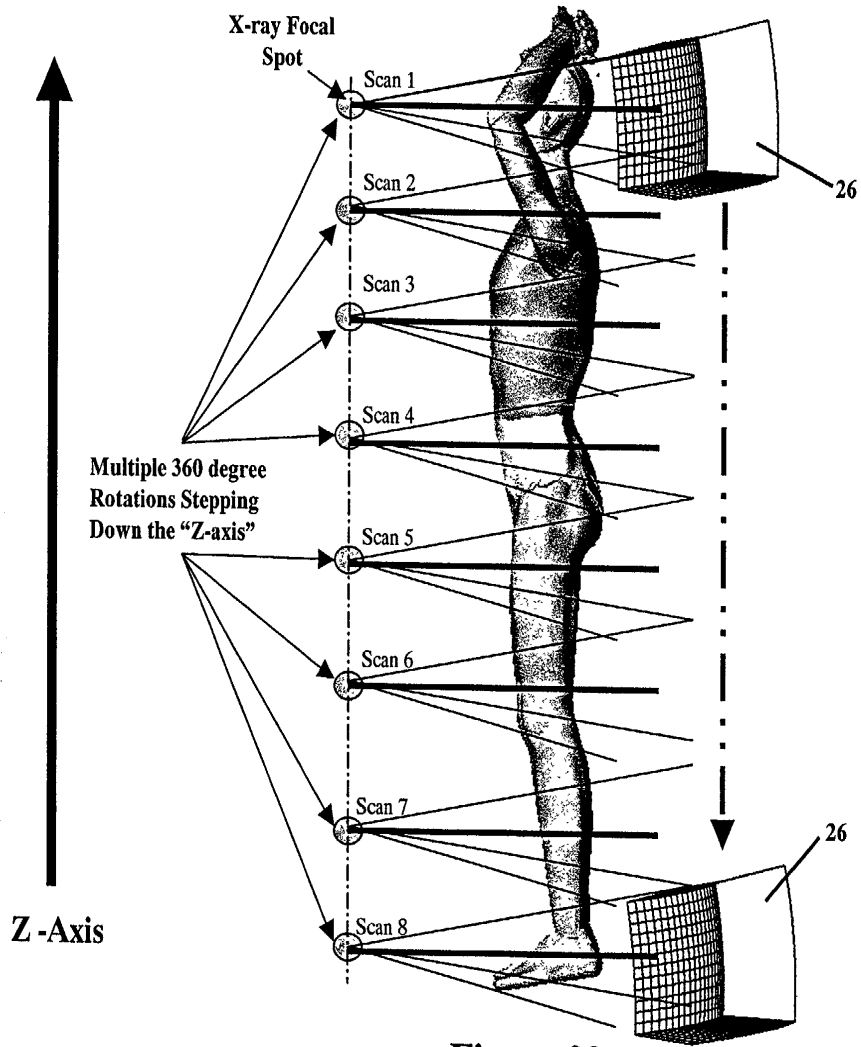


Figure 23

Spiral 3D X-Ray, DAQ and VCT for Cone Beam Reconstruction

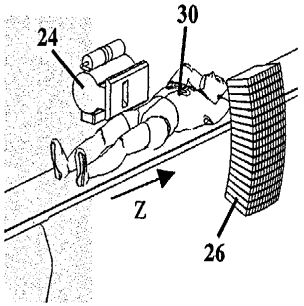


FIG. 24a

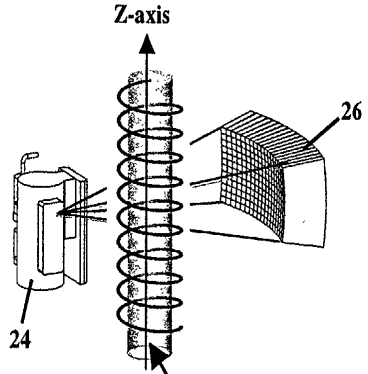


FIG. 24b

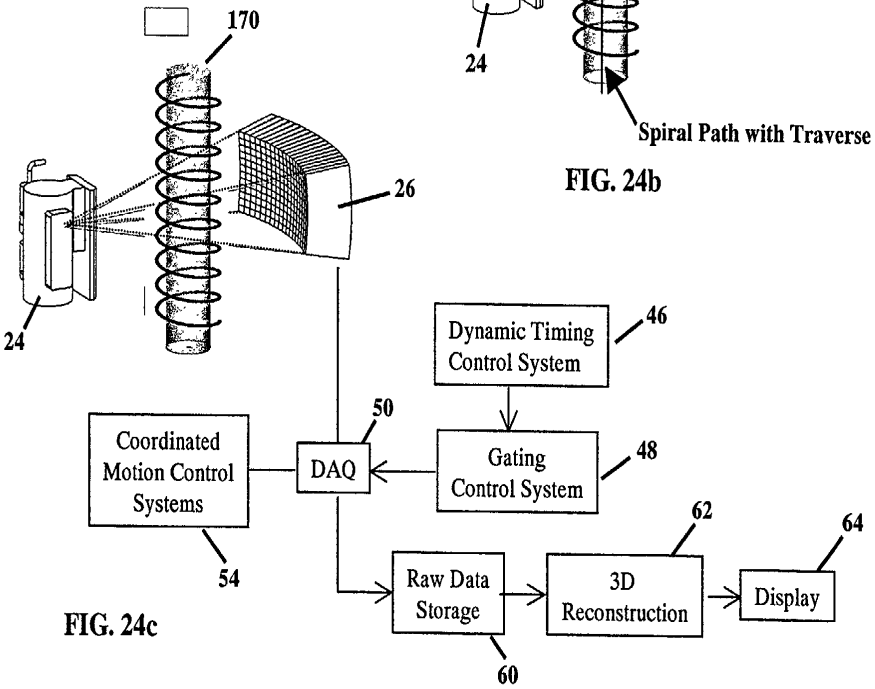


FIG. 24c

Figure 24

Spiral VCT with Multiple Heads

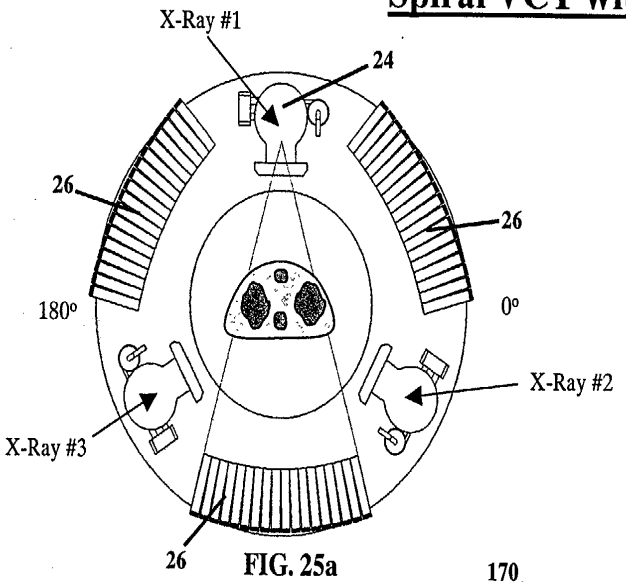
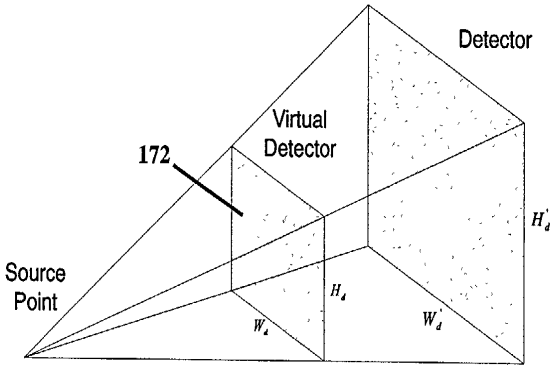


FIG. 25a



Detector Projection to Scan Center

FIG. 25c

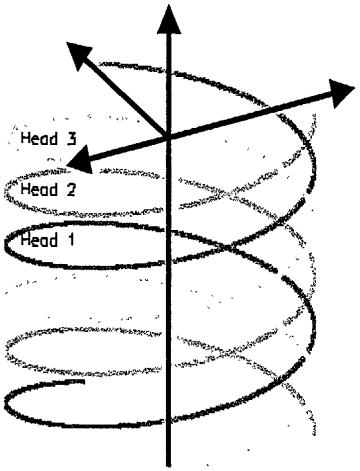
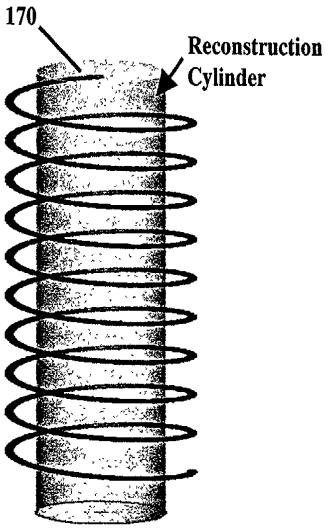
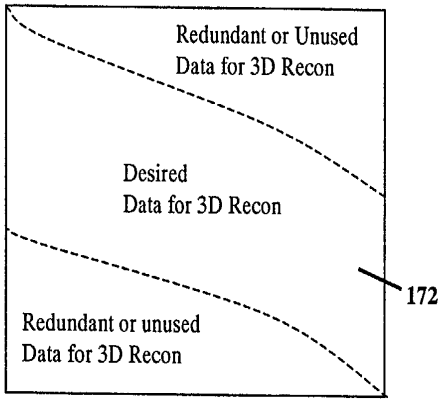


FIG. 25b

Spiral Path with 3 Heads with respective Central Rays on Reconstruction Cylinder





Virtual Detector Sampling Region

FIG. 25d

Figure 25

Cone Beam Slant Source Collimation for Spiral VCT Imaging

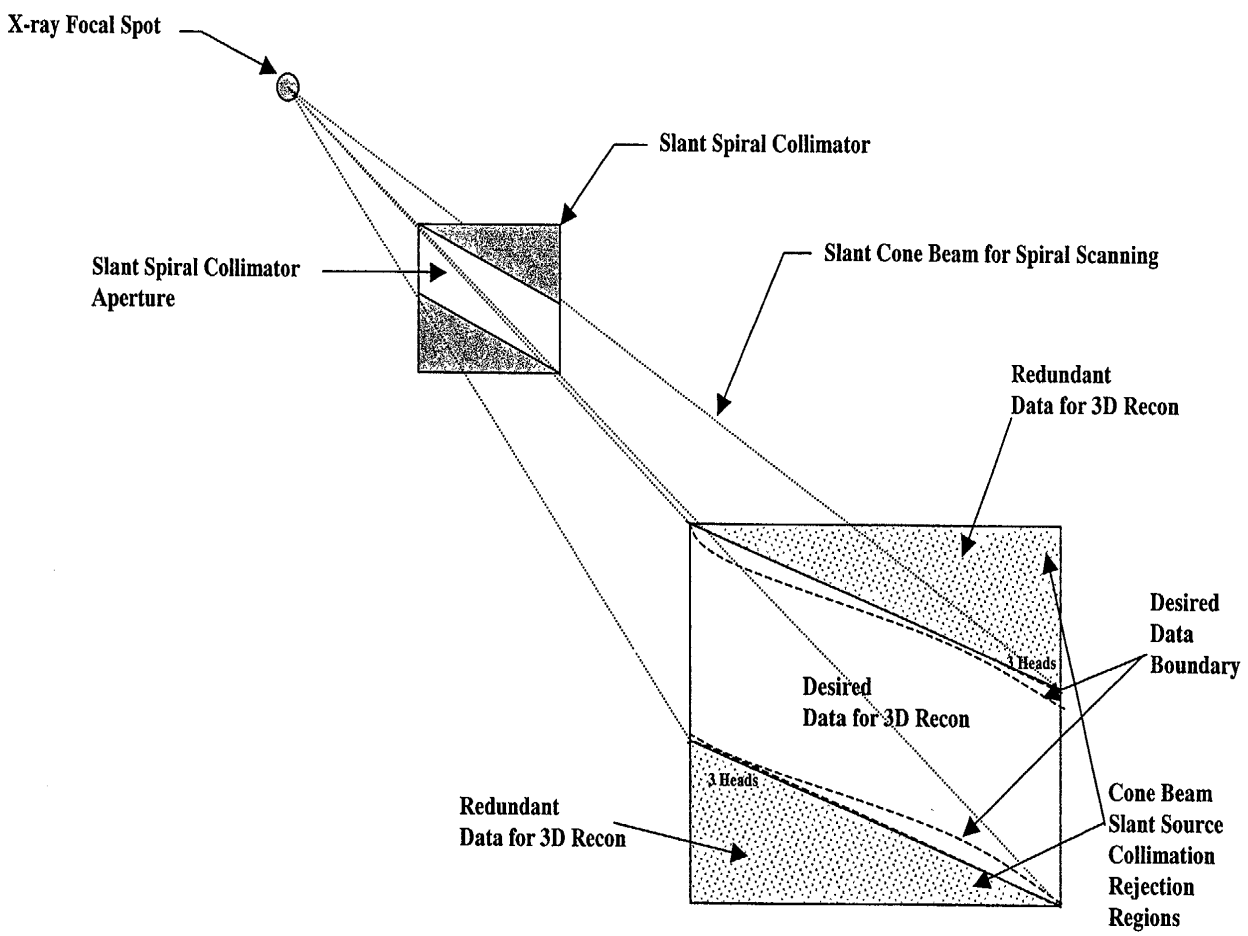


Figure 26

Multi-Plane Planning System Imaging

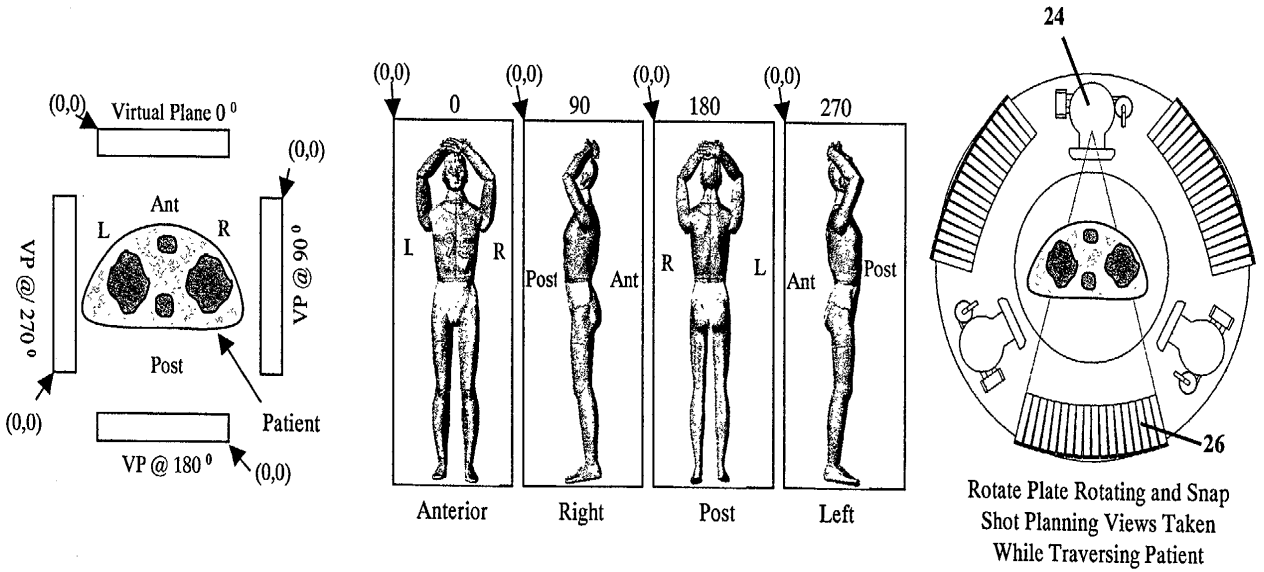


Figure 27

Whole Body Dose Control From Planning System

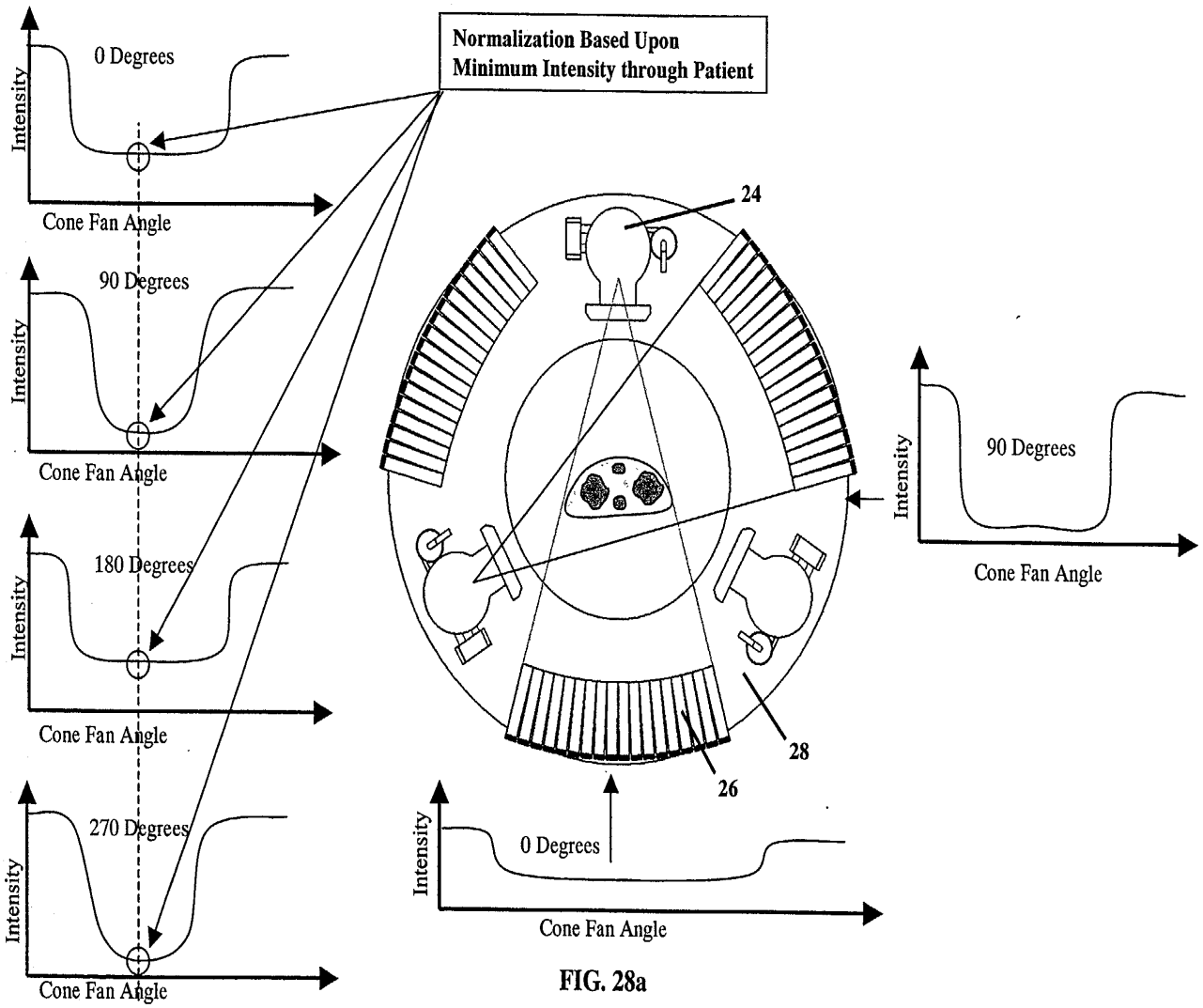


FIG. 28b

FIG. 28a

Figure 28

Dynamic Timing Control

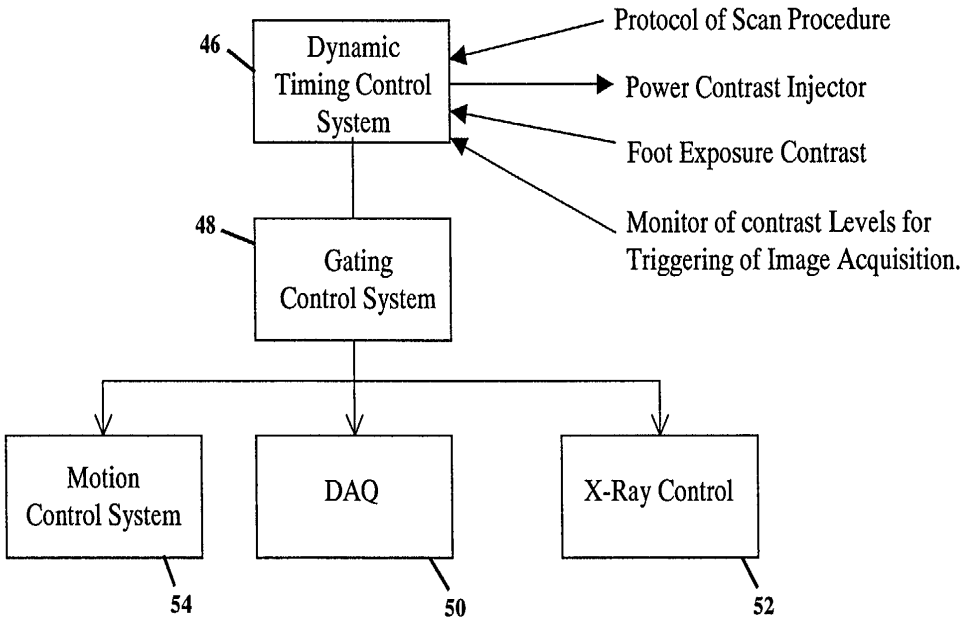


Figure 29

Retrospective Gated Imaging System

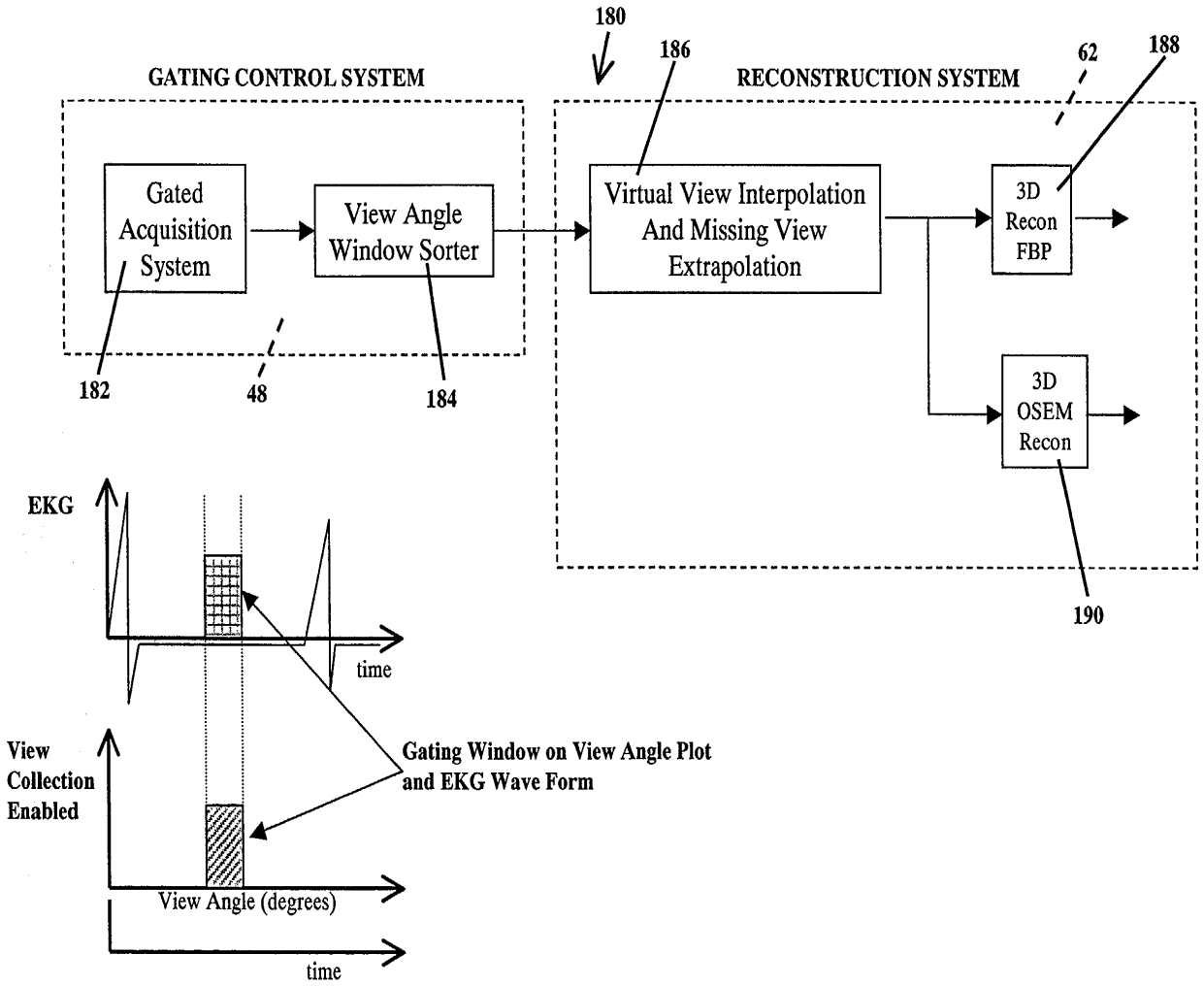
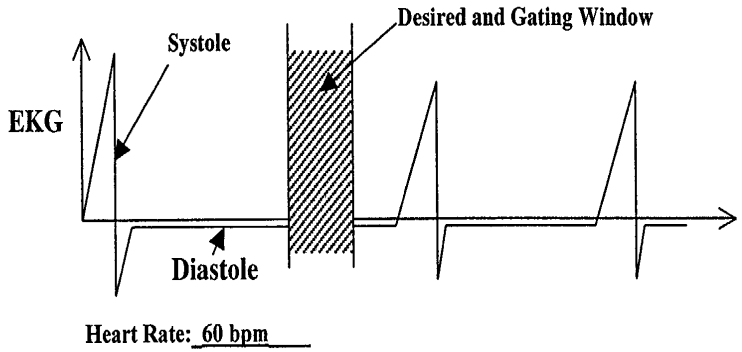


Figure 30

Prospective Gating Control System with Cardiac EKG



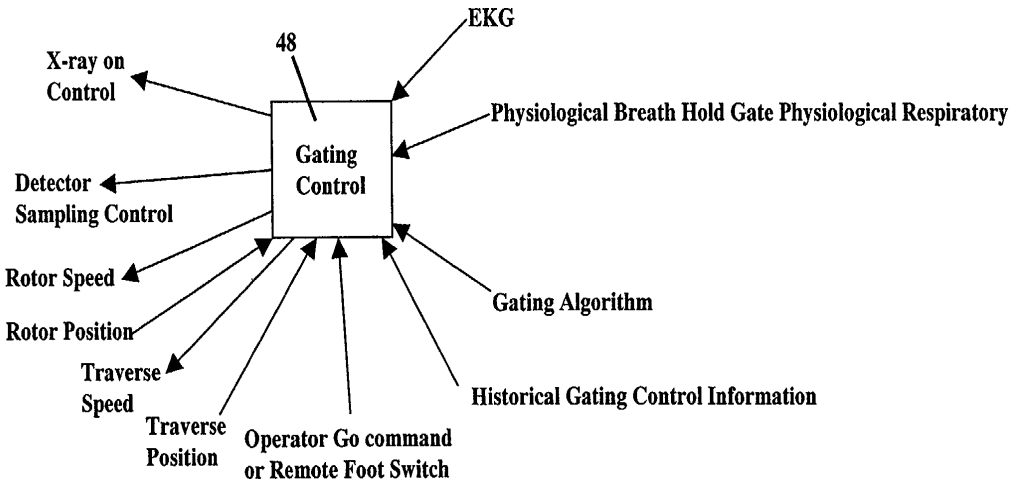
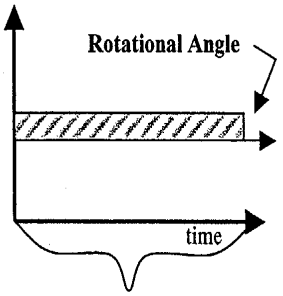


Figure 31

Prospective and Retrospective Gated DAQ and Reconstruction Imaging

Prospective Gating Control



Gate Time for 1 VCT
Image Volume

FIG. 32a

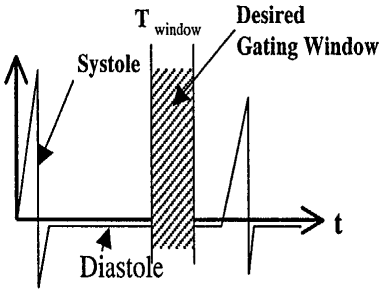
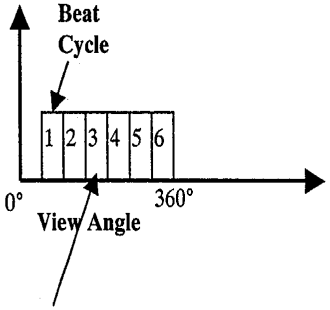


FIG. 32b

Retrospective Gating Control



Multiple cardiac cycles to fill needed
Views. Collect all views in (n) cycles of Heart.

FIG. 32c

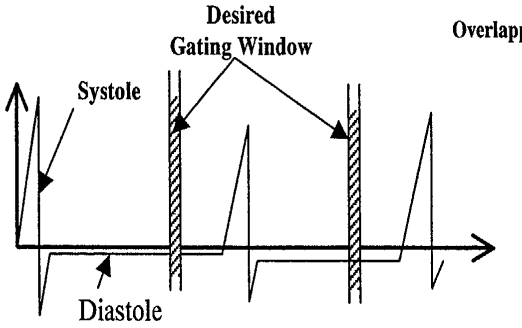


FIG. 32d

Multi Cycle – Contiguous

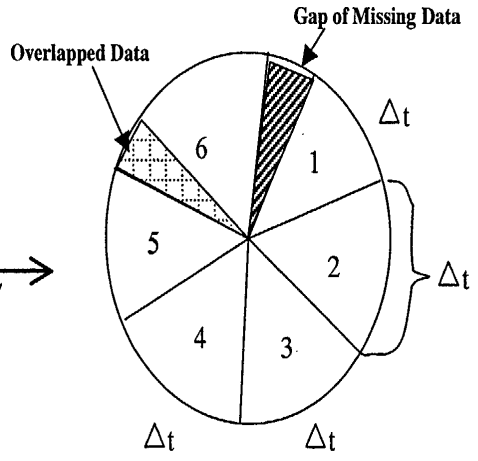


FIG. 32e

Figure 32

Gated DAQ and Reconstruction for Retrospective Cine' Dynamic Cardiac Imaging

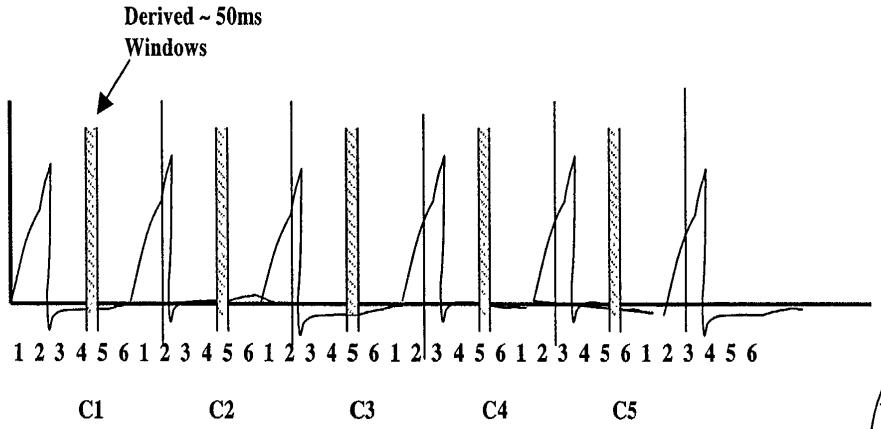


FIG. 33a

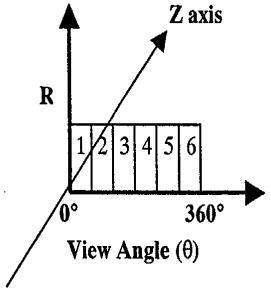
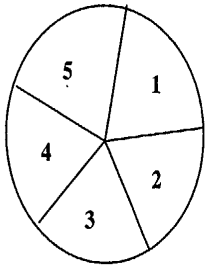


FIG. 33b

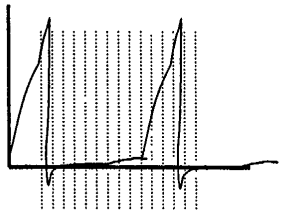
Views or θ/sec = 360 ° / .25 = 1440 °/sec
½ ° View Spacing = 2880 views/sec

Desired Window: 50ms
In One Window: 2880 x 5 x 10^{-2} = 144 views
72 degrees

3 cycles for 180 ° 3 x 72 = 216°
5 cycles for 360 °



5 Sectors of Pie Diagram



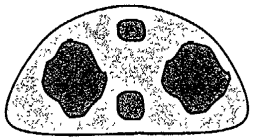
Average EKG

FIG. 33c

Figure 33

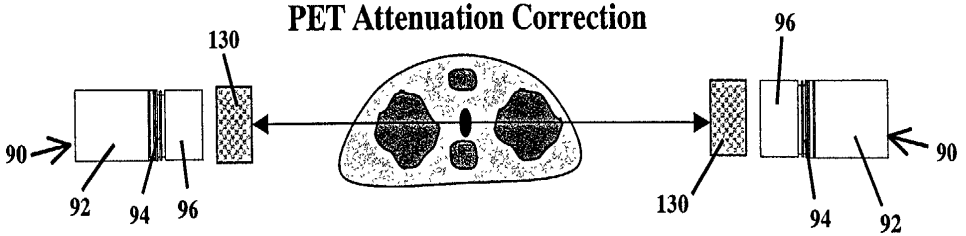
PET Transmission, Attenuation & Scatter Correction

VCT Attenuation MAP



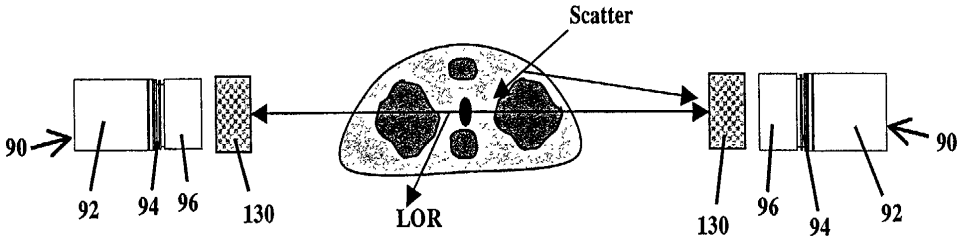
Transmission Attenuation
Map at 511 KEV Energy Level from VCT Images

PET Attenuation Correction



Correction Map for PET New Corrected PET
Projections for OSEM Recon.

PET Scatter Correction

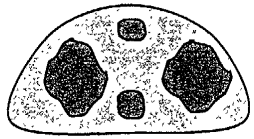


Scatter Correction from VCT Images and
Count Rates on a Projection View Basis

Figure 34

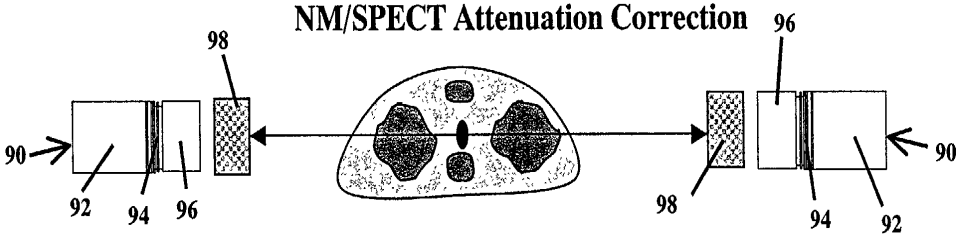
NM/SPECT Transmission, Attenuation & Scatter Correction

VCT Attenuation MAP



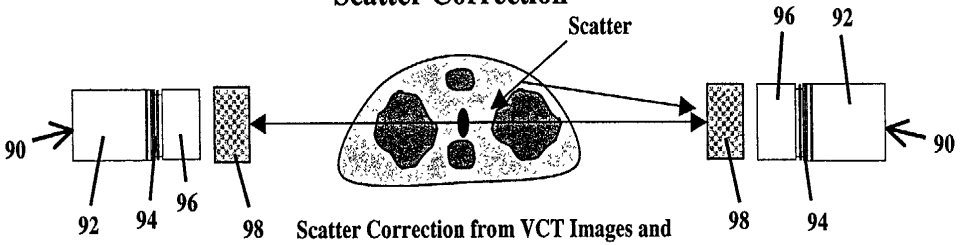
Transmission Attenuation
Map at NM/SPECT Energy Levels from VCT Images

NM/SPECT Attenuation Correction



Correction Map for NM/SPECT New Corrected
SPECT Projections for OSEM Recon.

Scatter Correction



Scatter Correction from VCT Images and
Count Rates on a Projection View Basis

Figure 35

Patient Fused Multi-Modality Imaging and Analysis System

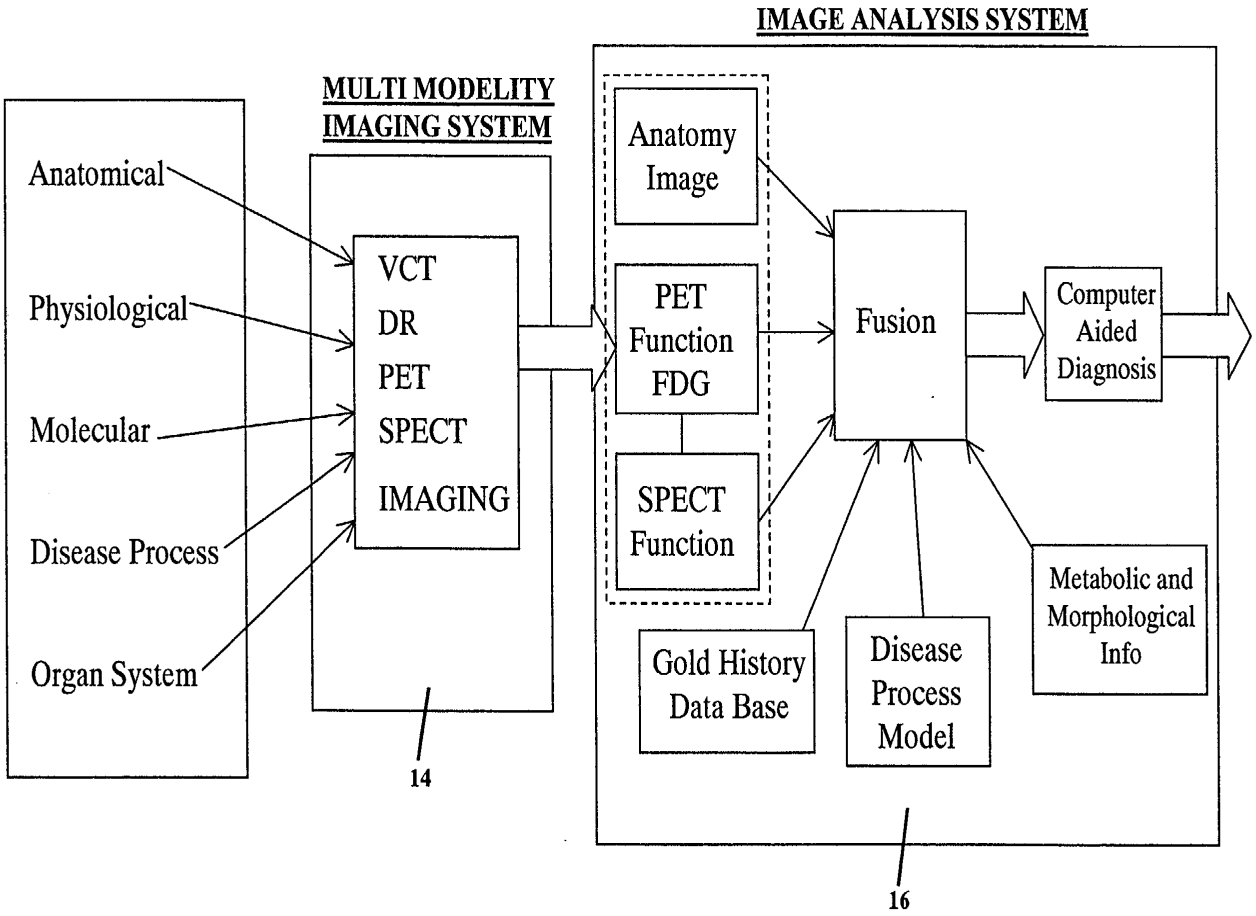


Figure 36

Interventional Image Control System

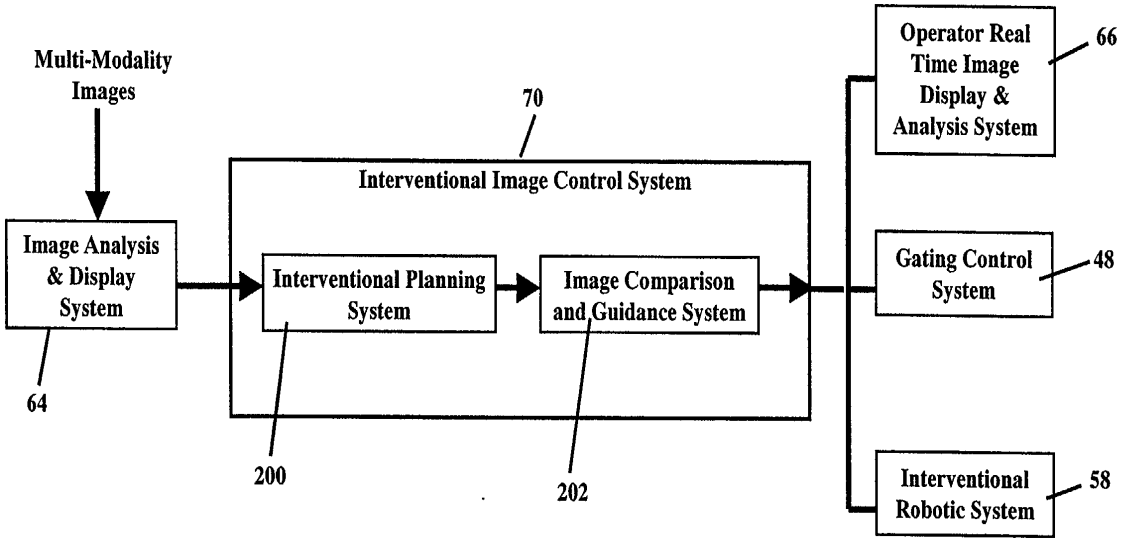


Figure 37

Multi-Modality Imaging with Independent X-Ray VCT, PET, and NM/SPECT Image Acquisition System

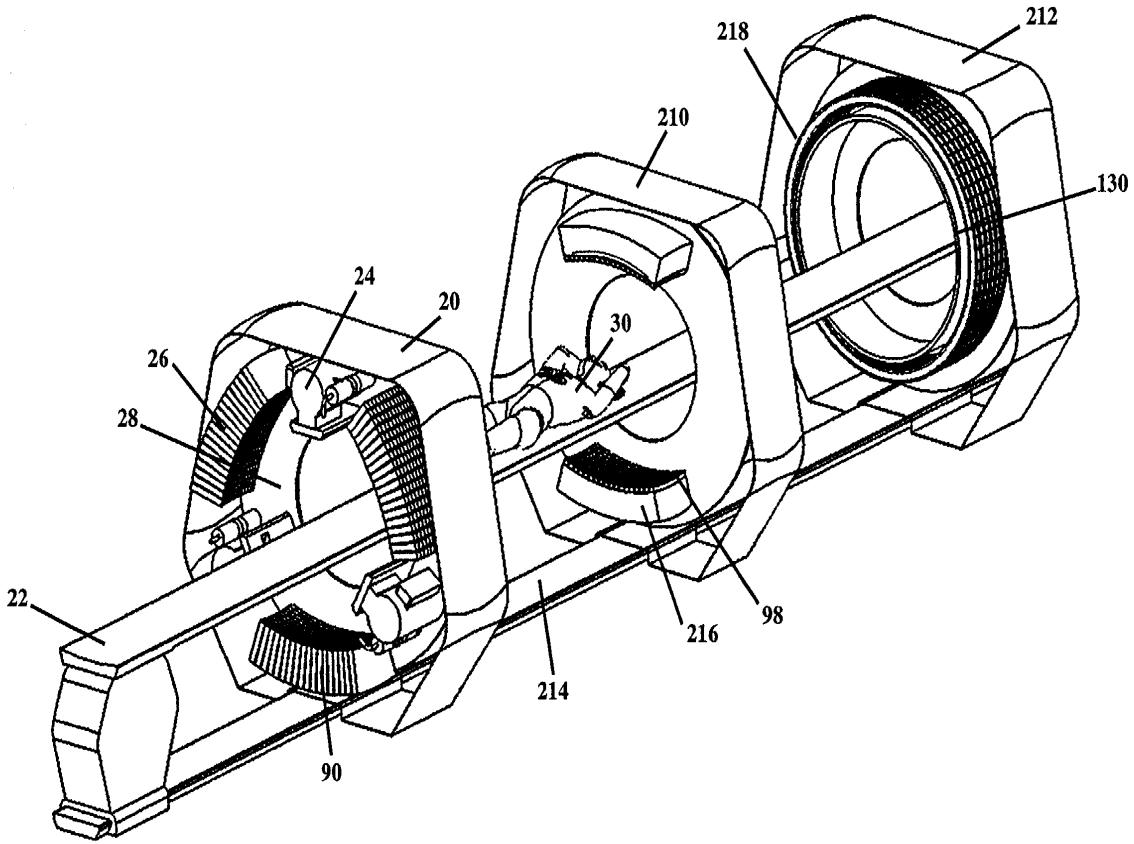


Figure 38

Multi-Modality Imaging with Independent X-Ray Single Head VCT, PET, and NM/SPECT Image Acquisition System

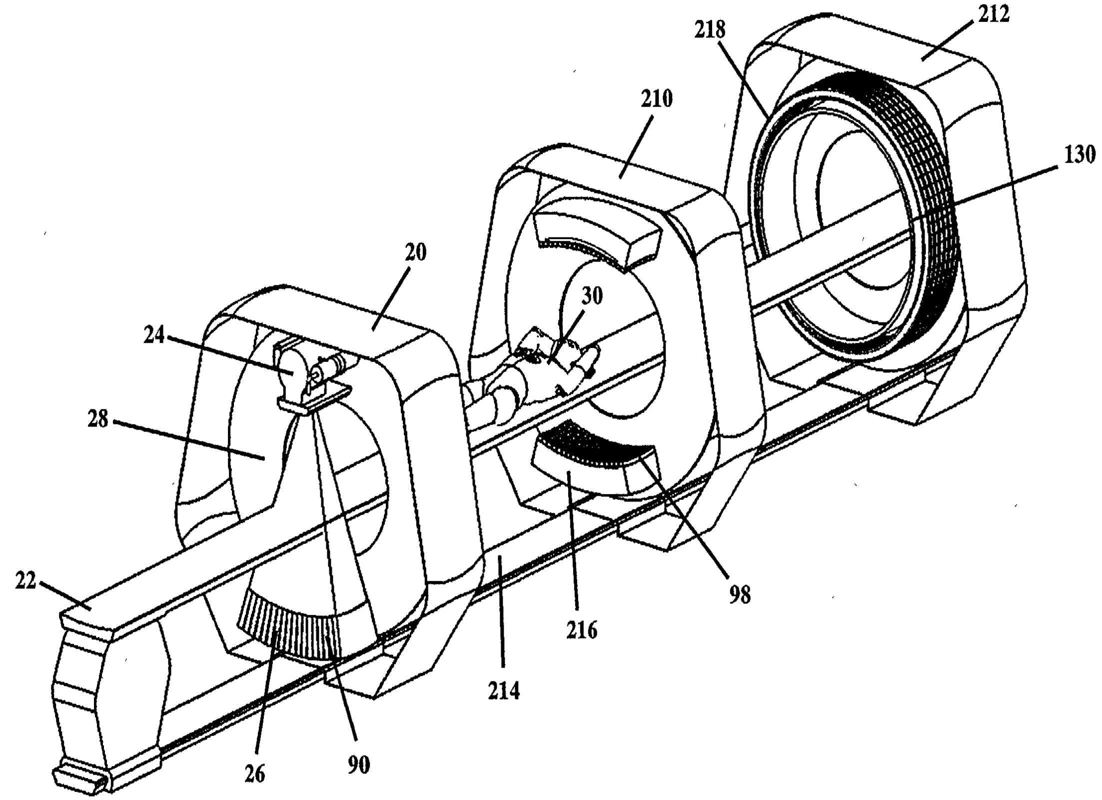


Figure 39

Multi-Modality Imaging with Independent X-Ray 4th Generation VCT, PET, and NM/SPECT Image Acquisition System

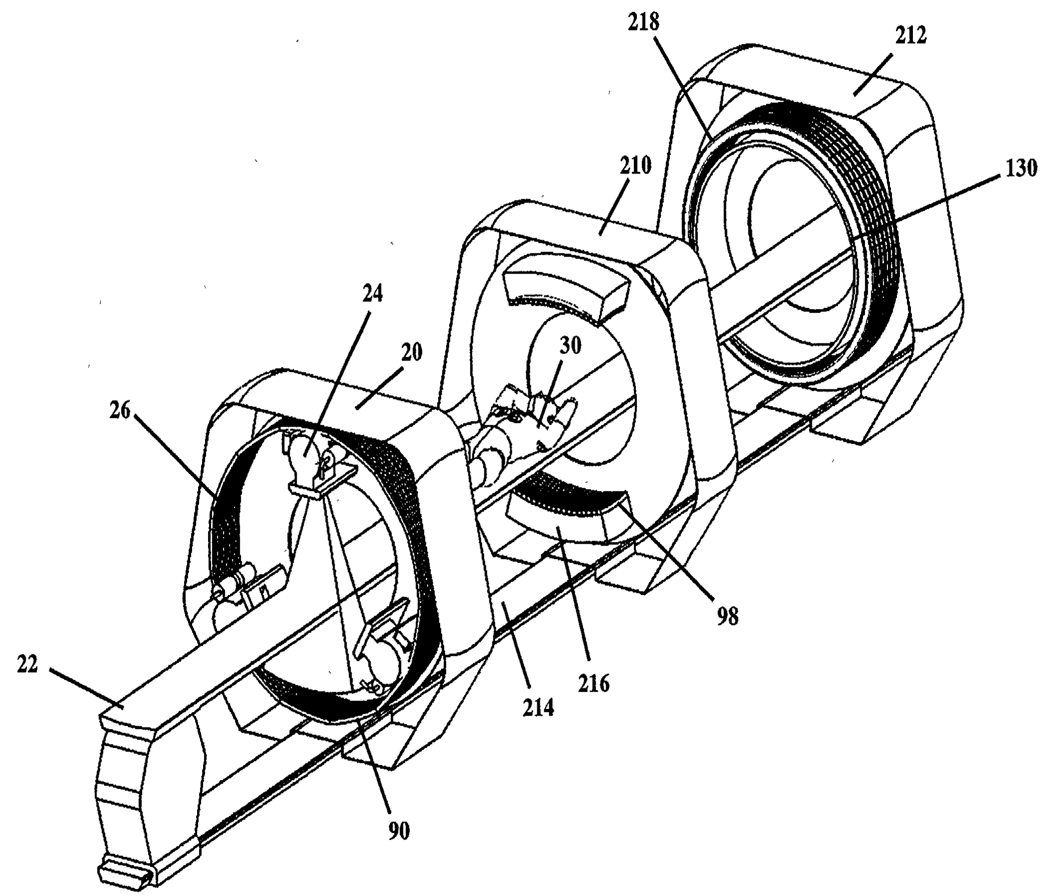


Figure 40

Multi-Modality Imaging System with Stationary Focused 2D Curved Detector for VCT, PET and NM/SPECT Imaging

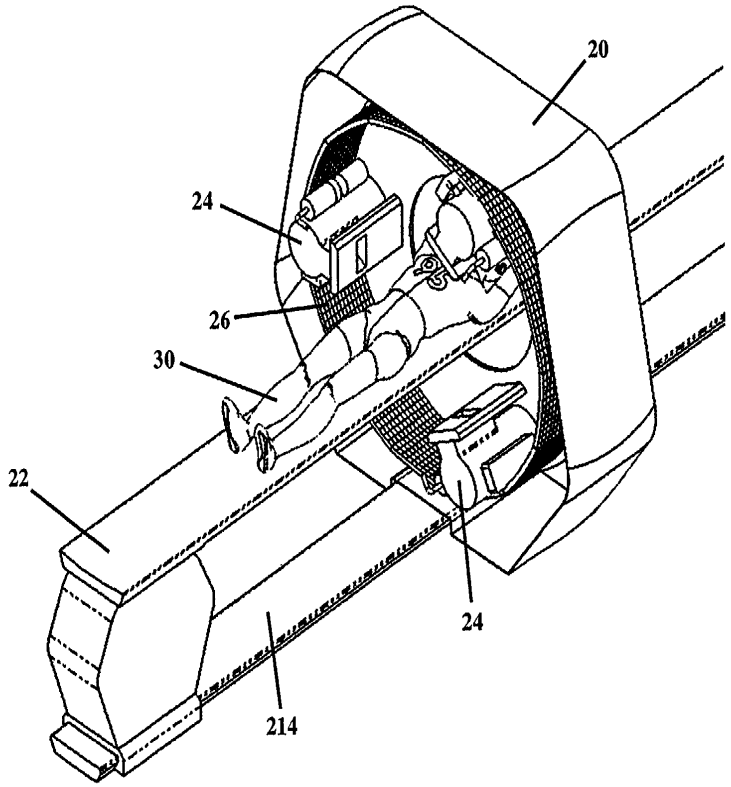


Figure 41

Multi-Modality Imaging with Common Gantry and Independent X-Ray VCT, PET, and NM/SPECT Image Acquisition System

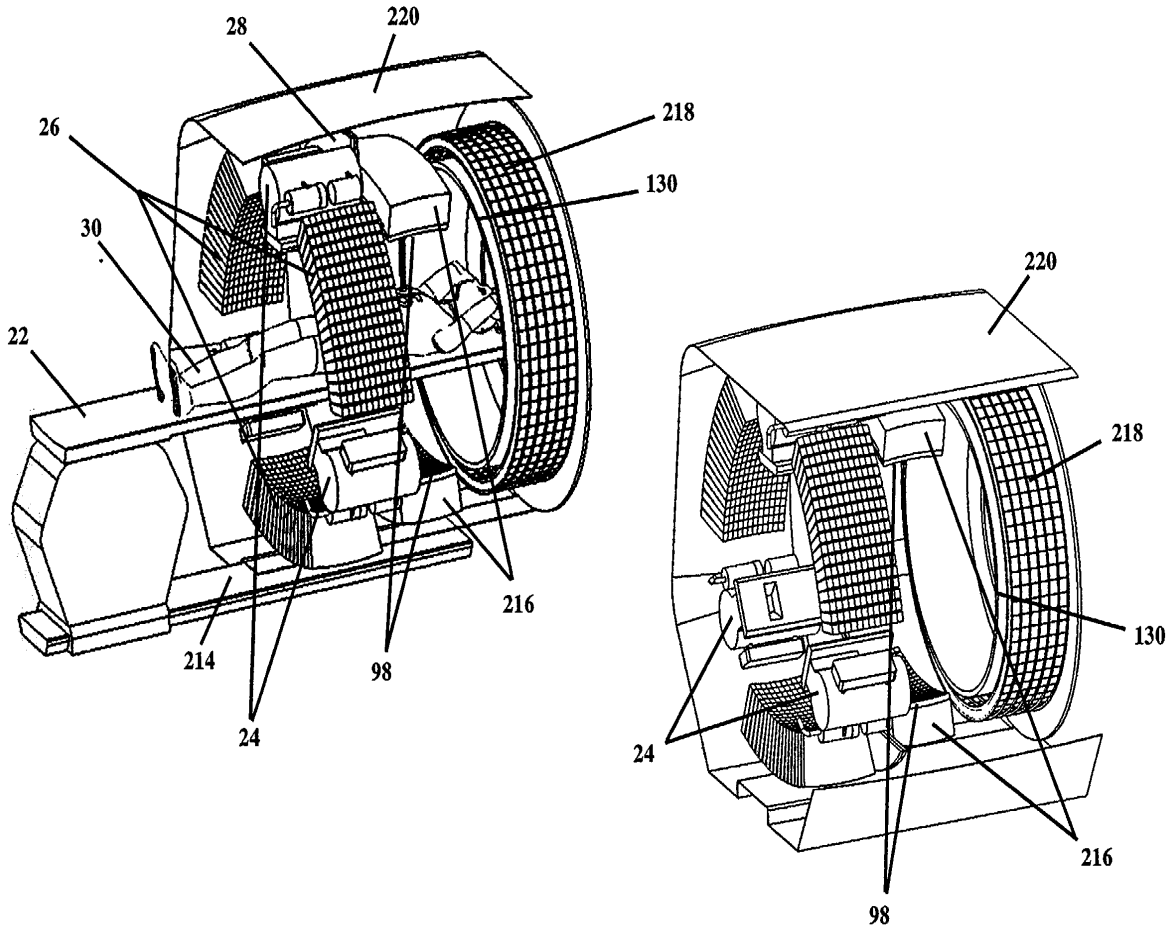


Figure 42

Multi-Modality Imaging with Common Gantry and Independent X-Ray Single Head VCT, PET, and NM/SPECT Image Acquisition System

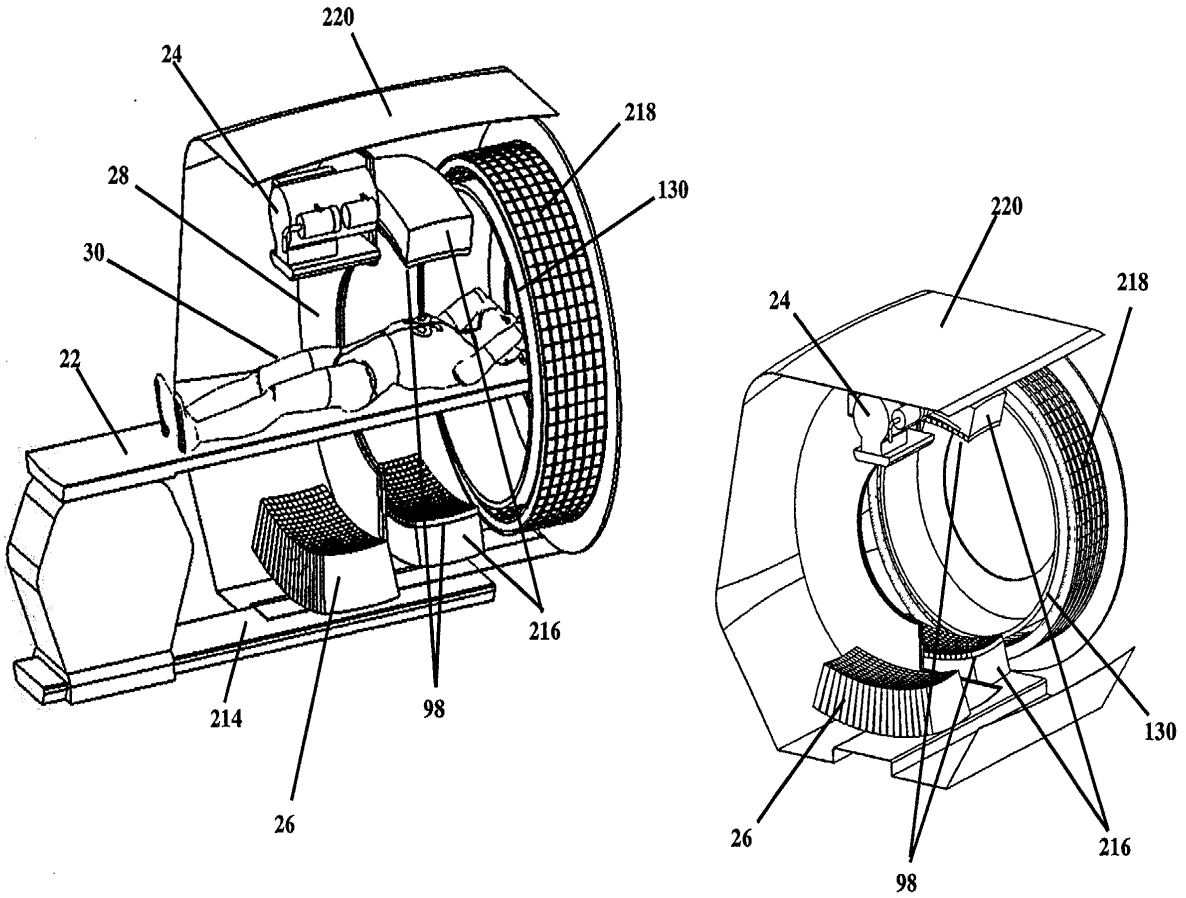


Figure 43

Multi-Modality Imaging with Common Gantry and Independent X-Ray 4th Generation VCT, PET, and NM/SPECT Image Acquisition System

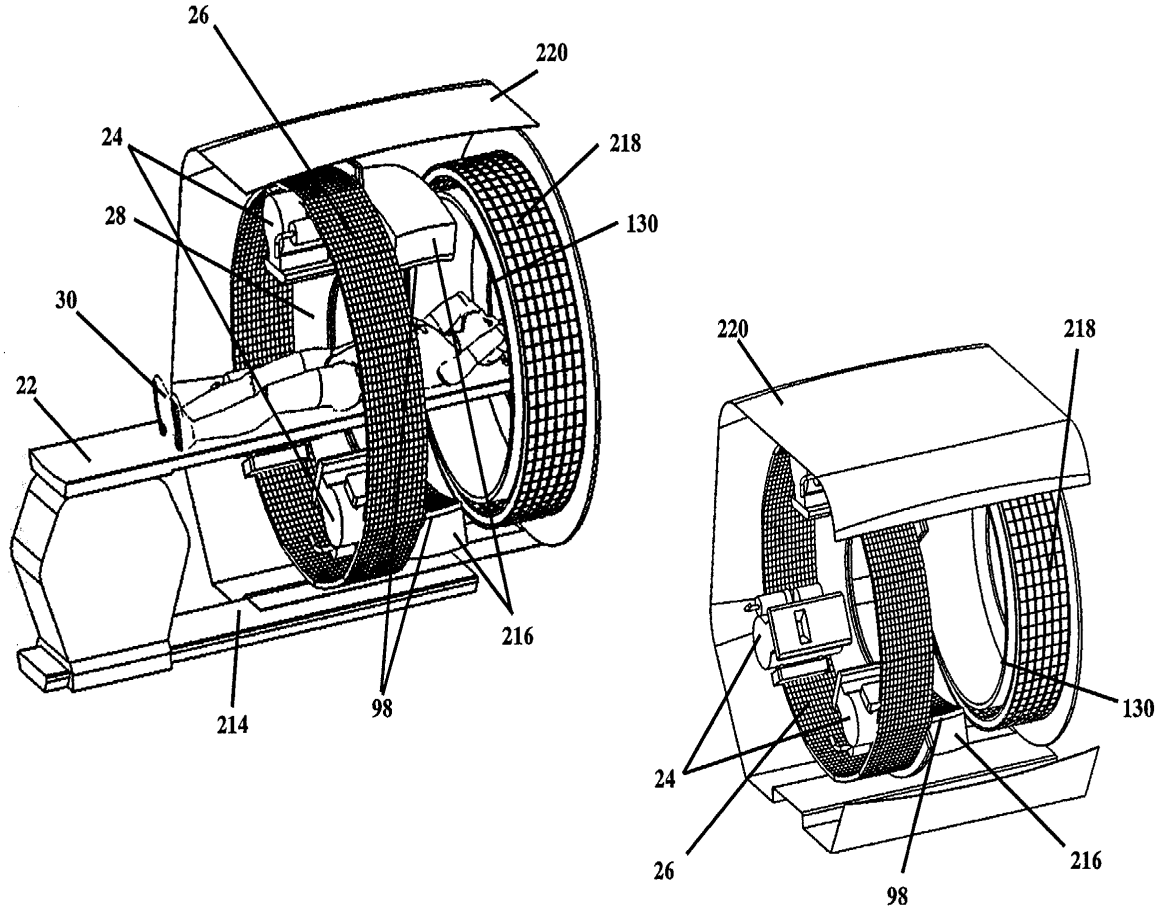


Figure 44

Multi-Modality Imaging with Common Gantry and Independent Single X-Ray 4th Generation VCT, PET, and NM/SPECT Image Acquisition System

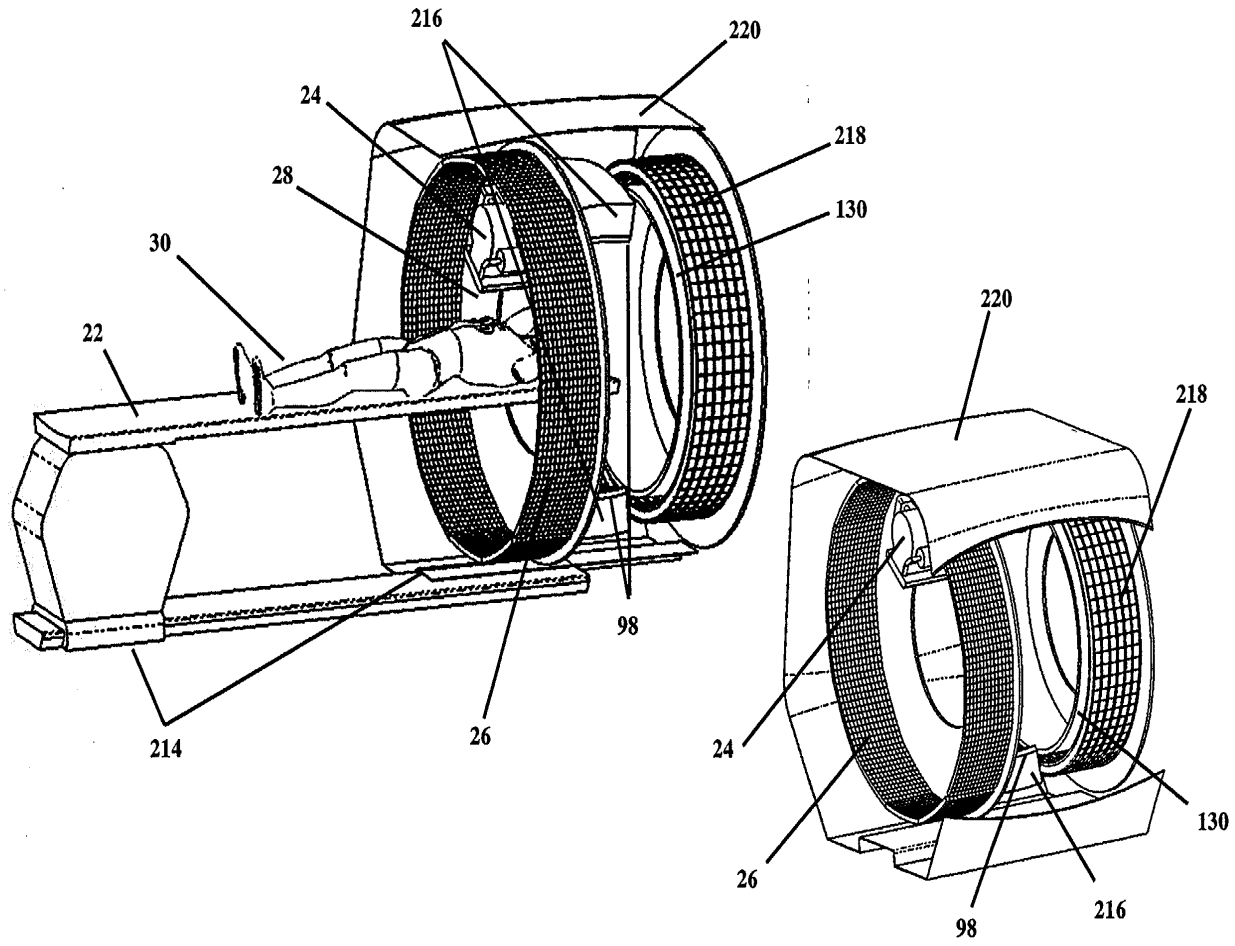


Figure 45